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NEWS—Society's Progress in 50th Year; What We Have Learned in 1952; ASTM Spring Meeting and Committee Week; 1953 Annual Meeting Symposiums.

PAPERS—Humidity Corrosion Test; Equipment for Buffing Rubber Specimens; Transformer Oil; Tension Testing Apparatus at Subatmospheric Temperatures; Reproducibility of Impact Test Results.

American Society for Testing Materials

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Significant Progress in All Fields of ASTM Work Mark Golden Anniversary Year

Record Breaking Meeting, Huge Publication Program, Advances in Research Highlight Society's 50th Year

THE YEAR 1952 was an outstanding one in many respects. Being the Fiftieth Anniversary Year, elaborate plans were made for a number of special features at the Annual Meeting, including the holding of a number of special symposiums, and also the participation of quite a number of guests from abroad. The Society was saddened by the death of its Executive Secretary in the midst of the plans for the Fiftieth Anniversary Meeting. Most of the plans for observing the Fiftieth Anniversary proceeded, making the year 1952 what might be termed "a banner year" albeit with an element of sadness due to the death of the Society's guiding spirit. In a sense, the year was made one of commemoration, not only of the Fiftieth Anniversary, but of its executive officer, C. L. Warwick.

Particular emphasis was placed upon the technical discussion at the Annual Meeting, which resulted in a number of outstanding technical publications. However, being the Book of Standards year, considerable attention was given by the technical committees to the review and the perfection of the Society's standards.

The organization of a number of new committees during the past few years is bearing fruit in the development and promulgation of standards in these newer fields, so that the year 1952 was indeed a heavy one from the point of view of recommendations on standards. The culmination of standards work is the appearance of the 1952 Book of Standards, a seven-part publication of some 10,000 pages.

Publications

NINETEEN hundred and fifty two was a very important publication year. The fact that this is the year that the Book of Standards is issued of itself makes it of outstanding importance but in addition to this a number of other significant publications have appeared. Of these, special mention should be made of a 50-Year Index of Technical Reports and Papers. While the publications actually covered are those up to 1950, nevertheless the publication represents a commemorative volume for the Fiftieth Anniversary and gives a very good idea of the many publications issued by the Society in the first fifty years of operation.

The Book of Standards is being issued for the first time in seven parts, the size having grown to such an extent that further breakdown was necessary. Also for the first time Bible paper is being used in order to keep the bulk of the individual parts to a convenient size. While mention of the work on the Book of Standards was completed before the close of the year, the books themselves will be forwarded to the members during the first few months of the new year.

While only a start has been made in issuing the many special technical publications resulting from the symposiums that contributed to the Fiftieth Anniversary Meeting, the year of 1952 was nevertheless a heavy publication year so far as STP's are concerned, many of them covering symposiums held prior to the Annual Meeting.

STP 56 G—Bibliography on Electrical Contacts
STP 114 —Symposium on Bulk Sampling
STP 115 —Papers on Evaluation of Soaps and Detergents
STP 116 —Symposium on Flame Photometry
STP 117 —Symposium on Measurement of Consumer Wants
STP 118 —Symposium on Structural Sandwich Construction
STP 119 —Symposium on Thermal Insulating Materials
STP 120 —Selection and Uses of Engine Antifreezes
STP 121 —Papers on Statistical Aspects of Fatigue
STP 122 —Symposium on Surface and Subsurface Reconnaissance
STP 123 —Symposium on Acoustical Materials
STP 124 —Report of the Elevated-Temperature Properties of Stainless Steels
STP 125 —Bibliography of Photoelectric Spectrophotometric Methods of Analysis for Inorganic Ions
STP 126 —Symposium on Consolidation Testing of Soils
STP 127 —Changes in Characteristics of Portland Cement as Exhibited by Laboratory Tests Over the Period 1904 to 1950 by H. F. Gonnerman and William Lerch
STP 129 —Symposium on Determination of Elastic Constants
STP 135 —Symposium on Insulating Materials

Another monumental publication on which the major part of the work was completed during the year are the ASTM-IP Petroleum Measurement Tables. Mention should also be made of the ASTM Manual of Engine Test Methods for Rating Fuels and the fourth set of cards of X-ray diffraction data.

New Fields of Work

Only one new technical committee was organized during the year, namely, E-14 on Mass Spectrometry. The establishment of this one committee, however, is of considerable significance. It provides a forum for the interchange of information on mass spectrometry. Much of the work of the committee at least in its early years will be the sponsoring of meetings and the presentation of papers discussing various aspects of the subject. These discussions may later show the way to desirable avenues of standardization.

The scopes of several technical committees were extended and the Joint Committee on Chemical Analysis by Powder Diffraction Methods was reorganized so as to place this work on a firmer foundation, including the adoption of a set of by-laws which should serve as a charter for the committee.

Meetings

Mention has already been made of the Fiftieth Anniversary Meeting held in New York, which was the crowning event of the year. The attendance at this meeting was the highest in the Society's history, the recorded attendance being 2606. Of even more significance, however, was the number of technical sessions held (36) many of them devoted to symposiums in specific fields including an international session on Interpretation of Non-Destructive Tests. Most of these technical sessions were very well attended and much material of value was presented, leading to a number of interesting publications.

The New York Committee on Arrangements under the chairmanship of J. R. Townsend, together with the Committee on Papers and Publications, provided for an outstanding meeting in many respects, both of a technical nature, and in entertainment features.

New Lecture

The First Gillett Memorial Lecture was presented by N. L. Mochel, West-

inghouse Electric Corp., who repeated certain portions together with additional material as a part of the Society's participation in the Centennial of Engineering in Chicago.

An outstanding Marburg Lecture on "Non-Destructive Testing" was presented by R. C. McMaster, Battelle Memorial Institute, who also used this lecture as a basis for talks given at two meetings sponsored by district councils in California. Many other district meetings were held, in many cases providing opportunity for the members in the various areas to meet the President. The Cleveland District acted as host for the Spring Meeting at which the technical feature was a Symposium on Testing Metal Powders and Metal Powder Products. Many committee meetings were held both at the time of the Annual Meeting and Committee Week and also independently.

General Review of Technical Activities

Most of the committees were quite active during the year, partly for the reason that in the year in which the Book of Standards is issued it is desirable to have all of the standards reviewed and set forth in the Book of Standards in their latest revised form. It also encourages the submission of new material for inclusion in the Book. The activities in several fields are set forth below, and are attributed to the many individuals responsible for the Society's technical product.

Steel

For a number of years Committee A-1 has been developing mechanical testing procedures for the products covered in its specifications. In 1948 the Tentative Methods for Tension Testing of Steel Spring Wire (A 318) were published, and in 1950 the Tentative Methods and Definitions for Mechanical Testing of Steel Bars (A 330) appeared. In 1952 the Tentative Methods and Definitions for Mechanical Testing of Structural Steel (A 359) became available. Other subcommittees have developed procedures for testing steel forgings, castings, and sheet and strip, but these have not been assigned ASTM designations because of a project which is expected to reach fulfillment in 1953, namely, a manual for the mechanical testing of steel. This manual will include a general section covering the procedures and definitions common to all the products, followed by other sections describing procedures and definitions peculiar to each product.

Since the publication in 1948 of the Tentative Method of Macroetch Testing and Inspection of Steel Forgings (A 317) there has been a concerted effort to obtain illustrations of the various types of defects encountered in steel forgings. This effort reached its conclusion in 1952 when Method A 317 was revised to include such illustrations in an appendix to the method.

Due to the rapid growth of ASTM specifications covering steel pipe and tube, there have been instances where the same material covered in two or more specifications has been assigned different grade designations. This confusion has also carried over into steel forgings, particularly those classes of forgings which are used in conjunction with pipe and tubing at elevated temperatures. Following an extensive review of the situation, in 1952 the grade symbol designations were coordinated by revising the grade numbers in many of the specifications.

Because of the need expressed by industry for a specification covering alloy-steel bars suitable for nitriding there were published in 1952 the Tentative Specifications for Alloy-Steel Bars for Nitriding (A 355). The most controversial point in this development was the microstructure requirements. After long debate it was decided to establish limits for primary free ferrite area based on the cross-sectional area, but to permit other percentages if agreed upon between the manufacturer and purchaser.

Emergency alternate provisions for four of the specifications covering alloy steel bars were published in 1952. Boron steels and "TS" grades have been permitted to be furnished to Tentative Specifications for Heat-Treated Alloy-Steel Bars (A 286), for Alloy-Steel Bars to End-Quench Hardenability Requirements (A 304), for Hot-Rolled Alloy-Steel Bars (A 322), and for Cold-Finished Alloy-Steel Bars (A 331).

In the bolting field, widely used grades BA, BB, and BC were deleted from the Tentative Specifications for Alloy-Steel Bolting Materials for High-Temperature Service (A 193). In their place the Tentative Specifications for Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts (A 354) were issued which include grades BB, BC, and BD.

Material furnished to the Tentative Specifications for Quenched-and-Tempered Steel Bolts and Studs with Suitable Nuts and Plain Washers (A 325) has been used at an increasing rate in structural applications. Since the original specifications were not written primarily for this purpose, they have been reviewed and revised this year to include many recommendations from the structural steel field.

The Tentative Specifications for Alloy-Steel Castings for Valves, Flanges, and Fittings for High-Temperature Service (A 157) originally contained the low-alloy steels as well as the high-alloy ferritic and austenitic steels for these applications. In 1949 it was realized that the complexity of coverage did not result in a very workable specification. Consequently the low-alloy grades were deleted from Specifications A 157 and the Tentative Specifications for Alloy-Steel Castings for Pressure-Containing Parts Suitable for High-Temperature Service (A 217) were developed to cover these grades. In 1952 Specifications A 157 were completely withdrawn when the high-alloy ferritic and austenitic grades were covered by the issuance of the Tentative Specifications for Ferritic and Austenitic Steel Castings for High-Temperature Service (A 351).

The publication in 1952 of the Tentative Specifications for Heavy-Walled Carbon and Low Alloy Steel Castings for Steam Turbines (A 356) covering castings for cylinders (shells), valve chests, throttle valves, etc., provide for castings in which the wall thickness is over 1 in. normally poured at moderate temperatures in dry sand molds.

Two new specifications for steel for low-temperature applications were also approved—the Tentative Specifications for Ferritic Steel Castings for Pressure-Containing Parts Suitable for Low-Temperature Service (A 352), and for Forged or Rolled Carbon- and Alloy-Steel Flanges, Forged Fittings, and Valves and Parts for Low-Temperature Service (A 350).

Wrought Iron

Following the reorganization of Committee A-2 on Wrought Iron in 1950, the committee turned to the specifications under its jurisdiction in 1952, and compared them with present commercial practice. As a result of the review the Standard Specifications for Common Iron Bars (A 85 – 36) have been discontinued since this material is no longer a commercial product. Likewise the requirements for charcoal iron have been deleted from the former Standard Specifications for Lap-Welded and Seamless Steel and Lap-Welded Iron Boiler Tubes (A 83 – 46). Since Committee A-2 shared joint jurisdiction with Committee A-1 over Specifications A 83, this deletion automatically shifted sole jurisdiction to Committee A-1.

In two other specifications, namely, the Standard Specifications for Welded Wrought Iron Pipe (A 72 – 45) and for Wrought Iron Plates (A 42 – 47), the tables of dimensional tolerances were revised to reflect present commercial practice. The section on bend testing in the Standard Specifications for Solid Staybolt Wrought Iron (A 84 – 39) and for Hollow-Rolled Staybolt Wrought Iron (A 86 – 39) were revised to more clearly describe the test.

Cast Iron

A new Tentative Specification for Chilled and White Iron Castings (A 360 – 52 T) has resulted from intensive work in Committee A-3. These specifications cover two types of castings: *Type A*—Castings made of iron, which when cast against a chiller, have a surface free of graphitic carbon; the balance of the casting consisting of mottled and gray iron, and *Type B*—Castings free of graphitic carbon as-cast due to selected chemical composition. Information on acceptance tests for these castings is included in the specifications, including a step test bar for obtaining tension test specimens from the gray iron portion of the castings.

Corrosion of Iron and Steel

Satisfying a long-time need of the roofing sheet industry as well as the farmers, Committee A-5 developed and had accepted by the Society the Tentative Specifications for 1.25-oz. Ordered Coating (Pot Yield) Zinc-Coated (Galvanized) Iron or Steel Roofing Sheets (A 361 – 52 T). The new standard at present covers only 1.25-oz coatings but will be expanded to cover other weights.

The biennial reports of the Subcommittee on Inspection of Black and Galvanized Sheets and the Subcommittee on Hardware Tests were published in 1952. The first report contains data for final inspections at Brunot Island, Pittsburgh, Pa.; Sandy Hook, N. J.; and Key West, Fla. on sheets exposed for 26 years. The second report includes the latest inspection data from Key West, Fla. (last report, 1948) and State College, Pa. The tests at Sandy Hook, N. J.; Altoona, Pa.; and Brunot Island, Pittsburgh, Pa., have been discontinued.

Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys

A new scope for Committee A-10 was approved by the Board of Directors during 1952, reading as follows: "In general, Committee A-10 has jurisdiction over the classification, specification requirements, methods of test, questions of utility and related subjects pertaining to those iron-base and other chromium-bearing alloys termed stainless, rustless, or heat resistant, whose primary characteristic is resistance to corrosive attack, elevated temperatures, or both." This revision in scope made possible the formation of a new Subcommittee on Specifications for High-Temperature, Super Strength Alloys. The subcommittee, under the chairmanship of H. D. Newell, was organized at the time of the Annual Meeting and is currently working on the so-called "jet" or "super" alloys.

Electrical Conductors

During the past few years there has been a growing consumer interest in steel reinforced aluminum cable (ACSR) having steel core wires with heavier-than-standard zinc coatings (galvanizing) to provide increased corrosion resistance. Committee B-1 therefore completed and approved in 1952 the Tentative Specifications for Zinc-Coated (Galvanized) Steel Core Wire (With Coatings Heavier Than Standard Weight) for Aluminum Conductors, Steel Reinforced (ACSR) (B 261 T).

The recent use of aluminum conductors in insulated products of the building wire class has indicated the need for conductors of a temper somewhat softer than hard drawn in order to provide the additional ductility needed in making connections to terminal screws, etc. After a thorough investigation the Tentative Specifications for Three-Quarter Hard Aluminum Wire for Electrical Conductors (B 362 T) was approved to fill these requirements.

Recognizing the need for suitable gages to control grooved trolley wire sizes and after several years of consideration, appendices were added in 1952 to the Standard Specifications for Bronze-Trolley Wire (B 9), for Copper Trolley Wire (B 47), and for Figure-9 Deep-Section Grooved and Figure-8 Copper Trolley Wire for Industrial Haulage (B 116). The appendices give dimensions for "go," "no go" slip gages for consideration and experimental purposes only. When experience indicates that the gages are satisfactory, it is proposed to revise the text of the specifications to require such gages.

Non-Ferrous Metals and Alloys

The proposed tentative specification for pig tin has been tabled until early 1953 pending developments and comments resulting from the two-session Symposium on Tin which Committee B-2 sponsored in connection with the 1952 Annual Meeting. This symposium will be available in published form in the near future.

Corrosion of Non-Ferrous Metals and Alloys

Atmospheric exposure specimens of copper, bronze, brass, aluminum, nickel, lead, zinc, and tin on test since 1931 were removed and a final inspection made in January, 1952. Weight loss determinations are being made and tension test specimens have been distributed to the cooperating laboratories for testing. It is the present plan of the subcommittee to complete the testing work in sufficient time to prepare a final report for presentation in 1953.

The first of three groups of the disk-type galvanic couples of the Aluminum and Magnesium Galvanic Corrosion Program were removed from exposure and are currently being tested for electrical resistance. Following resistance measurements the specimens will be disassembled, cleaned, and weighed. The second part of the program consisting of wire-wound bolts is nearing completion, and present plans call for exposure of the plate type couples of the third part within the next year.

Electrical Heating, Resistance, and Related Alloys

Committee B-4 continued its activities in the development of new and necessary standards in its field, submitting to the Society in 1952 six new tentatives:

Tentative Method of Test for Relative Thermionic Emissive Properties of Materials Used in Electron Tubes (B 270)
Tentative Method of Test for Sag of Tungsten Wire (B 269)
Tentative Specifications for High-Resistivity, Low-Temperature Coefficient Wire (B 267)
Tentative Specifications for Round Chromium-Copper Wire for Electronic Devices (B 268)
Tentative Method of Test for Determining Hardness of Contact Materials (B 277)
Tentative Recommended Practice for Sublimation Testing by the Electrical Resistance Method (B 278)

The last two tentatives, although approved too late to be included in the 1952 Book of Standards, will be included in the forthcoming compilation of B-4 standards and other selected standards related to the electron tube industry.

Copper and Copper Alloys

While there were many revisions in the copper and copper alloy specifications promulgated by Committee B-5, most of these were concerned with reflecting present industry practice. The most significant development during the year was the publication of two new specifications to cover products in general commercial usage but not possible to purchase under an ASTM designation. These new specifications were the Tentative Specification for Rectangular Copper Wire for General Purposes (B 272) and the Tentative Specification for Copper-Base Alloy Centrifugal Castings (B 271). The specification for centrifugal castings includes provisions for sampling for chemical analysis and physical testing, and describes test bar practice. For other requirements reference is made to the static casting specification for the class of alloy desired.

The most interesting development in Committee B-5 was a report on the effect of speed of testing on the tensile

properties of copper and copper-base alloys. This report, appended to the 1952 Preprinted Report of Committee B-5, presented the results of a series of round-robin tension tests by various government and industrial testing laboratories. Analysis of the data indicates that stressing rates from 30,000 psi per min to 90,000 psi per min do not have any significant effect on tensile properties.

Die-Cast Metals and Alloys

After several years of consideration in Committee B-6, approval was given to the inclusion of the alloy designations developed by Committee B-7 in all standards under B-6 jurisdiction. These designations are based on the Recommended Practice for Codification of Light Metals and Alloys, Cast and Wrought (B 275).

Light Metals and Alloys, Cast and Wrought

Significant in the accomplishments of Committee B-7 during the past year was the partial culmination of years of effort devoted to the development of a code system for the identification of light metals. The code system for alloy composition was adopted by the Society and appears in the 1952 Book of ASTM Standards as the Recommended Practice for Codification of Light Metals and Alloys (B 275). The code for temper designations has not as yet been accepted by the Society.

In addition to B 275, tentative specifications were accepted for Aluminum and Aluminum-Alloy Pipe and Tube for Pressure Vessel Applications (B 274) and Aluminum and Aluminum-Alloy Bars, Rods, and Shapes for Pressure Vessel Applications (B 273).

Specimens of the extensive aluminum and magnesium atmospheric exposure program were put on test at New York City, State College, Pa., Kure Beach, N. C., and Pt. Reyes, Calif., test sites. As soon as facilities are available specimens will be exposed at Freeport, Tex. The initial group of specimens has already been removed from the first three sites named.

Metal Powder Products

From reports of activities in Committee B-9 on Metal Powders and Metal Powder Products, it appears as though many test methods and specifications will be presented to the Society for publication in the next few years. This past year a Tentative Recommended Practice for Evaluating the Microstructure of Apparent Porosity in Cemented Carbides (B 276 – 52 T) was published. The recommended practice includes six photomicrographs of each of the three types of apparent porosity encountered in cemented carbides. The photomicrographs are graded numerically with increasing apparent porosity.

Particular note should also be taken of the Symposium on Methods of Testing Metal Powders and Metal Powder Products, which was held at the Spring Meeting of the Society in Cleveland. These papers and discussions will be published in January of 1953 in a booklet estimated to be 96 pages in size.

Cement

Fifty years of achievement were commemorated by Committee C-1 on Cement in 1952. The particular achievements of the year included further refinements in the specification for portland cement (C 150) in terms of air content, fineness, and time of set. Agreement was reached on an expansion limit, as measured by the autoclave test, for masonry cement. Further progress in the study of pozzolans was made, especially in the preparation of specifications for the use of fly ash.

Magnesium Oxychloride and Magnesium Oxysulfate Cements

A survey on the forms of lime and other deleterious effect on oxychloride cement and the preparation of a tentative method for shear strength of bonding media for oxychloride cement were the principal objectives of Committee C-2.

Chemical Resistant Mortars

A Tentative Specification for Sulfur Mortar (C 287 T) was issued in 1952, this being intended for use in chemical-resistant construction and particularly for joining chemical-resistant masonry. Much progress has been made in establishing methods for determining the bond strength and working and setting times on chemical-resistant mortars. A proposed method has been formulated for measuring water absorption, tensile and compressive strength of resin-base mortars.

Clay Pipe

All test procedures for determining the quality of clay pipe were separated from the individual ASTM specifications and grouped under a separate designation (C 301), thus removing considerable duplication in the several standards concerned. Committee C-4 completed a survey on establishing the preference for specifications for flue linings. Replies were received from 79 municipal officers well distributed over the United States. A recommended list of standard sizes of flue linings will be prepared and published for information purposes.

Lime

The most important developments in Committee C-7 on Lime during the year were the completion of a new settling test for lime; a new slaking test for quicklime, the apparatus being developed at MIT; and progress on new methods of determining available CaO and iron content of lime.

Refractories

A test method for determining carbon monoxide disintegration marked the first development in this new field covered by Committee C-8. This method is intended to show the comparative behavior of fireclay refractories under the disintegration action of carbon monoxide. A new edition of the Manual of ASTM Standards on Refractories was issued during the year, containing the latest ASTM standards and additional industrial surveys. A program of research on special refractories, including silicon carbide, fused alumina, fused magnesia, and fused alumina-silica refractories has been given further attention.

Concrete and Concrete Aggregates

With a background of over 30 years of research, four alternate freezing-and-thawing methods were developed during the year by Committee C-9. These methods involve rapid freezing and thawing in water (C 290), rapid freezing in air and thawing in water (C 291), slow freezing and thawing in water or brine (C 292), and slow freezing in air and thawing in water (in process of committee ballot). Another important activity has been in the study of potential alkali reactivity of aggregates and their effect on producing abnormal expansion in concrete when used with high-alkali cement. A chemical method was adopted at the Annual Meeting and bears the designation C 289. Further study of aggregates resulted in new tentatives being adopted covering descriptive nomenclature of constituents of natural mineral aggregates (C 294) and petrographic examination of aggregates or concrete (C 295). A complete revision of the Specification for Concrete Aggregates (C 33) was adopted, the principal change being that of including more specific limits on deleterious substances, soundness loss, and the inclusion of a maximum allowable abrasion loss for coarse aggregate. A proposed specification and a test method for fly ash for use as an admixture in portland-cement concrete has reached the final stage as a result of concentrated effort during the year.

Gypsum

A new section in the Standard Methods of Testing Gypsum and Gypsum

Products (C 26) was added by Committee C-11, dealing with a procedure for determining the water resistance characteristics of core-treated, water-repellent gypsum sheathing. The corresponding section to cover this type of sheathing board was added to the Standard Specification for Gypsum Sheathing Board (C 79). A complete revision of the Standard Specification for Sand for Use in Plaster (C 35) was accomplished, the feature being definite recognition of such lightweight materials as perlite and vermiculite.

Mortars for Unit Masonry

The long awaited Specification for Unit Masonry (C 270), adopted in 1951, received further important revisions, such as specifying more clearly when the proportion or the property specification shall govern, provision for use of admixtures or colors, and the deletion of a reference to lime as being strictly a plasticizing agent. Additional mortar proportions have also been included, especially to allow for a straight portland-cement mortar. Committee C-12 also accomplished a complete revision of the Specifications for Aggregate for Masonry Mortar (C 144), in which a separate grading has been set up for manufactured sand *versus* natural sand and limits which now include organic impurities and soundness loss. Efflorescence continued to receive attention.

Concrete Pipe

Two important projects received attention by Committee C-13, these being a proposed recommended practice for bedding and backfilling and a proposed specification for low-head pressure pipe. Certain revisions were adopted in the existing pipe specification involving constituents, reinforcing steel, and refinement of the 3-edge bearing test.

Thermal Insulating Materials

Following the initial three specifications promulgated by Committee C-16 in 1951, several additional specifications were adopted or have reached final draft in 1952. These new specifications are principally in the block and pipe insulation field. Test methods covering the basic properties of thermal conductivity of pipe insulation and of water-vapor permeability of thick materials were developed. The research project on determining the moisture effect on the thermal properties of insulating materials is now actually under way, with arrangements made for the testing program to be carried on at The Pennsylvania State College and with a considerable portion of the cost now to be underwritten. After a long period of investigation, a final draft was agreed upon for a recommended practice for clearance of preformed pipe insulation.

Asbestos-Cement Products

The principal achievement of Committee C-17 during 1952 was the adoption of the Tentative Specification for Asbestos-Cement Pressure Pipe (C 296). This represents the completion of an extended study and investigation of the requirements needed for such a specification. The measurement of handleability of asbestos-cement products has been a current project of the committee.

Structural Sandwich Constructions

An additional tentative method was promulgated by Committee C-19 covering a tension test in flatwise plane of sandwich constructions (C 297). Under consideration were several methods for determining properties of core materials and strength tests covering sandwich constructions, including a peel test.

Acoustical Materials

The measurement of sound absorption by means of reverberation methods progressed considerably during the year. Committee C-20 has now agreed upon a proposed method involving the use of the impedance tube. Other types of tests for measuring sound absorption under discussion include the box method and the close-up method, the latter being a means of measuring acoustical materials in finished constructions. Proposed test methods have also been drafted covering strength tests and light reflection.

Ceramic Whiteware

A considerable amount of research and study was necessary before Committee C-21 could properly develop proposed test methods which will be acceptable to the industry. A number of methods are now in their final stages dealing with the properties of raw materials and ceramic whiteware products. These methods include sieve analysis, water content chemical analysis, sampling and shrinkage of clays, and the determination of true specific gravity, modulus of rupture, and linear thermal expansion of whiteware specimens.

Porcelain Enamel

Warpage, adherence, and reflectance of porcelain enamel products are measured by proposed test methods now completed by Committee C-22. Several other test methods received attention during the year for measuring such properties as gloss, abrasion, thickness, tearing, sagging, consistency, and fusion.

Paints and Related Materials

Committee D-1 celebrated the 50th anniversary of its organization. To mark this milestone, the committee sponsored a Symposium on Paint Testing which reviewed the accomplishments of Committee D-1 and covered in detail the many advances made by the committee on accelerated tests for protective coatings, exterior exposure testing on wood, tests for physical properties, painting of metals, varnish, cellulosic coatings and related materials.

The cooperative relations with the Federation of Paint and Varnish Production Clubs continued quite active during the year and have now resulted in the joint approval by both the Federation and ASTM of some 52 methods. Two of the new joint methods issued this year merit special mention, namely, the Test for Viscosity of Paints by Ford Viscosity Cup, and the Test for Fineness of Grind of Pigments in Vehicle Systems, such as paint and enamel. Both of these methods are widely used in the paint industry.

Another important contribution was a new Test for Measurement of Wet Film Thickness of Paint Coatings. This covers two procedures, one using the interchemical wet film thickness gage, and the other the Pfund gage. Two other new methods worthy of mention provide a Procedure for Determining Temperature Change Resistance of Lacquer Films on Wood, and a General Test for Color of Clear Liquids Using the Platinum Cobalt Scale.

Petroleum Products and Lubricants

Committee D-2 had several outstanding accomplishments this year. One is of international significance, namely: ASTM-IP Petroleum Measurement Tables developed jointly by the ASTM and the Institute of Petroleum (London). These tables are being issued in three volumes: (1) American Edition, (2) British Edition, (3) Metric Edition. The text matter in the Metric Edition is published in English, French, and Spanish. The magnitude of this project can be judged from the fact that some 600,000 six-digit numbers appear in the 39 tables. Well over a quarter million IBM cards, weighing over two tons, were used in the calculations and proofreading of the tables. These measurement tables will be used throughout the world as a basis for calculating volumes of petroleum products between the purchaser and seller.

Another noteworthy accomplishment of Committee D-2 was the second edition of the ASTM Manual of Engine Test Methods for Rating Fuels. The five test methods included in this manual are used throughout the petro-

leum industry for evaluating the combustion characteristics of motor, aviation, and diesel fuels. The manual includes information on the best practices currently in use for the operation and maintenance of the test engines, also for use and preparation and blending of the cross reference fuels, laboratory facilities, insulation of test units, etc.

Another significant publication which will make its appearance early in 1953 are cooperative methods of calibrating liquid containers (upright tanks). These methods have been in preparation for several years by a committee made up of representatives of users and manufacturers of upright tanks as well as representatives of inspection companies. These methods establish the necessary procedures in volume calculations for the accurate determination of the incremental and total capacities of liquid containers, mobile or stationary, larger than a drum. The methods will be presented in two parts, the first covering the accumulation of all required dimensions and pertinent facts—"field data" for the accurate determination of the volume of a container, and second, a guide for the translation of field data and to the finished incremental capacity tables.

The ASTM Manual on Measurement and Sampling of Petroleum and Petroleum Products was also revised and brought up-to-date during the year. This manual contains six ASTM methods required to measure and compute the quantity of oil in storage and in transportation tanks of various types, and for obtaining typical samples of the tank contents. The six methods in the manual cover procedures for gage, temperature measurement, volume calculations, sampling, and tests for water and sediment and gravity.

Important changes were made this year in the Specifications for Motor Gasoline (D 439 – 52 T). The main feature of this revision was to specify the octane number in terms of the Research Method in place of the Motor Method. An addition was also made to the appendix of the specifications discussing the research and motor octane number tests. Committee D-2 has received requests for methods of testing jet fuels. The first of these was issued as tentative this year covering a Method for Determining Marcaptan Sulfur by the Color Indicator Method in Jet Fuels.

Gaseous Fuels

Committee D-3 completed this year a new Method of Sampling Manufactured Gas which was accepted as tentative by the Standards Committee and will be issued under the designation D 1247 – 52 T. This method is a companion standard of the present Tentative Methods of Sampling Gas (D 1145 – 50 T). Important changes were made in the Methods of Test for Specific Gravity of Gaseous Fuels (D 1070 – 49 T) which was also adopted as standard. The committee has also recommended that the Specific Gravity Method (D 1070) and the Standard Method of Test for Calorific Value of Gaseous Fuels by the Water-Flow Calorimeter (D 900 – 48) be submitted by the Society to the American Standards Assn. for approval as American Standard.

Road and Paving Materials

A well-rounded program was carried on by Committee D-4 in the development of standards for both bituminous mixtures and other constituents. Data have been collected on the effect of water on compressed bituminous mixtures, as well as on bituminous coated aggregates. A stripping test for bitumen-aggregate mixtures was developed for committee consideration. Viscosity of emulsified asphalts and the curing properties of bituminous materials have been studied, and proposed methods will be presented at an early meeting. Three new tentatives were approved during the year pertaining to joints, these being a specification and test method for concrete joint sealers (D 1190 and D 1191) and a specification for preformed expansion joint fillers for concrete (D 544). The latter tentative is in effect a replacement of a former specification under the same designation, this new tentative now including three types.

Bituminous Waterproofing and Roofing Materials

The first coverage of standards for siding materials was consummated by Committee D-8 in the approval of tentative specifications and test methods for asphalt insulating siding surfaced with mineral granules (D 1226 and D 1228). Another new tentative adopted was a Specification for Asphalt-Base Emulsion for Use as Protective Coatings for Built-Up Roofs (D 1167). Proposed test methods are being checked by round-robin testing on stain and compatibility of bituminous roofing materials.

Coal and Coke

Committee D-5 made plans during the year to sponsor a Symposium at the 1953 Annual Meeting of the Society. Developed by the Subcommittee on Sampling it is tentatively titled Symposium on Statistical Aspects of Coal Sampling.

The committee has continued to participate in international discussions relating to coal and coke. The former chairman, W. A. Selvig, attended two meetings at Geneva, Switzerland, of the Classification Working Party, Coal Committee, and Economic Committee for Europe. At these meetings considerable progress was made in reaching agreement by the delegates on the basis of a scheme for classification of coal for international use.

Paper and Paper Products

Four new tentative methods of test for paper and one new tentative method of test for paperboard were adopted in 1952. These methods are concerned with pinholes in glassine and other greaseproof papers, zinc and cadmium, contrast gloss of paper at 57.5 deg, specular gloss of paper at 75 deg, and flat crush of corrugated paperboard. Committee D-6 has been active in developing further new test methods including a close relationship with the Technical Association of the Pulp and Paper Industry.

Wood

In recognition of the increased interest in fiberboards, a new Subcommittee on Structural Fiberboard was organized during the year by Committee D-7. Members participated in the presentation of papers in a session on wood during the Centennial of Engineering. Further study and more definite plans were laid during the year for a research program on wood pole testing. Four important standards were rewritten, these being the Standard Specification for Round Timber Piles (D 25), Standard Methods of Testing Small Clear Specimens of Timber (D 143) and Plywood, Veneer, and Other Wood and Wood-Base Materials (D 805), and the Tentative Methods of Test for Evaluating the Properties of Fiber Building Boards (D 1037).

Electrical Insulating Materials

Committee D-9, through its Subcommittee on Mica, has been taking a very active part in the development of international standards for raw mica. Members of the committee attended as American delegates a three-day meeting of Technical Committee 56 on Mica of the International Organization for Standardization (ISO). At that meeting a number of agreements were reached on specifications for natural muscovite mica based on visual quality as covered by ASTM D 351 – 52 T.

Another accomplishment was the completion of the very extensive revision of the Specifications for Laminated Thermosetting Materials (D 709 – 52 T). The revision was prepared in cooperation with the National Electrical

Manufacturers' Association and with interested Government agencies and has resulted in practically identical requirements in the corresponding NEMA standard and military specification.

The committee has also continued its participation in international discussions on electrical insulating oils through the International Electrotechnical Commission. The committee has also continued its extensive studies of other problems dealing with the sludge evaluation of inhibited and uninhibited oils, the dielectric strength testing of oils, the evaluation of combined and corrosive sulfur in oil, and the determination of dissolved water in oil. A new Method for Insulation Resistivity of Electrical Insulating Oils of Petroleum Origin (D 1169 – 52 T) was issued as tentative.

Other noteworthy accomplishments included an extensive revision of the Tentative Methods of Testing Varnishes Used for Electrical Insulation (D 115 – 52 T), Methods of Test for Electrical Resistance of Insulating Materials (D 257), and Methods of Sampling Askarels (D 901). The new Tentative Specifications for Cellulose Acetate Sheet and Film for Primary Insulation (D 1202 – 52 T) were also completed in cooperation with Committee D-20 on Plastics.

Shipping Containers

The most important development in Committee D-10 during the year has been in cooperative testing to establish performance standards and to correlate testing data. This work has been concentrated to date on the vibration and drop test methods.

Rubber Products

Committee D-11 was the sponsor of a most significant Symposium on Recent Developments in the Evaluation of Natural Rubber.

Substantial progress was made during the year on a number of subjects including draft proposals on Tension Stress—Strain Testing, Tear Strength Testing, Hardness Testing, Rubber-to-Fabric Adhesion, and the du Pont Abrasion Test. Of outstanding significance was the completion of a revision of the SAE-ASTM Specifications for Rubber and Synthetic Rubber Compounds (D 735; SAE 10R). An article discussing details of this revision will appear in the ASTM BULLETIN for February, 1953.

New SAE-ASTM Tentative Recommended Practices for Classifying Elastomeric Compounds for Resilient Automotive Mountings (D 1207 – 52 T) were prepared as an aid to automotive engineers in selecting compressions of the desired characteristics intended. It supplements Specifications D 735 as applied to this specialized field.

An important addition was made to the American Standards for rubber protective equipment for electrical workers in the form of completely revised Specifications for Rubber Insulating Gloves (D 120 – 52 T) (ASA J6.6 – 1952). The revised specifications recognize three classes of gloves distinguished by their insulation levels as determined by proof voltage tests.

Another significant development was the Tentative Method of Test for Adhesives for Brake Lining and Other Friction Materials (D 1205 – 52 T) which had been prepared in response to a need created by a widespread adoption of the use of adhesives instead of riveting for application of brake lining in automotive vehicles. Proper evaluation of the adhesives and the techniques of application are essential.

The new Tentative Method of Test for Low-Temperature Compression Set of Vulcanized Elastomers (D 1229 – 52 T) was developed in an effort to improve means of evaluating aging characteristics of rubber compounds. The basic general Methods of Sample Preparation for Physical Testing of Rubber Products (D 15) were completely rewritten following studies extending over several years in order to bring these methods up to date, and to include various changes occasioned by widespread use of synthetic rubbers. The revised methods now give standard formulations for test purposes which use standard ingredients developed in cooperation with the National Bureau of Standards. Mixing procedures for the different types of synthetic rubber are also included.

Textile Materials

Committee D-13 had a very active and productive year which resulted in presentation of a number of new tentative methods at the June meeting. Representatives of Committee D-13 attended meeting of working groups of the ISO Technical Committee 38 on Textiles held in New York in connection with a series of meetings of ISO committees early in June.

Through efforts of the recently organized joint ASTM-AATCC Committee on Textile Test Methods there has been closer coordination of the test methods of the two organizations.

The improved ASTM Cotton Yarn Appearance Standards continued in great demand during the year both in the United States and in many countries throughout the world. Before the standards are issued they are examined and approved by a special committee which meets several times a year.

Two new methods of test for shrinkage in laundering of knit fabrics have been prepared in cooperation with that industry and in response to a request for a standardized shrinkage test. These methods provide procedures for testing knit cotton fabrics and knit rayon fabrics. Another timely method was the Test for Flammability of Clothing Textiles prepared jointly with the AATCC.

The Tentative Recommended Practice for Planning Interlaboratory Testing of Textile Materials (D 990 – 52 T) which has been quite widely used was further simplified by revisions adopted this year.

Changes were made in the Recommended Practice for Designation of Linear Density of Fibers, Yarns, and Other Textile Materials in Universal Units (D 861 – 52). This recommended practice is based on a direct decimalized system employing metric units, and multiples or submultiples when desired, as approved by ISO Technical Committee 38 on Textiles.

Following extensive cooperative interlaboratory studies, methods were completed for testing twine made from bast and leaf fibers. The procedures cover breaking strength, effective diameter, and yardage (linear density).

The General Methods of Testing Cotton Fibers (D 404 – 52 T) are now being thoroughly reviewed and brought up to date. Revisions were completed in two sections of these methods this year, both of which have been published as separate tentatives, the first covering Tentative Methods of Sampling Cotton Fibers for Testing (D 1441 – 52 T), and the second covering Tentative Method of Test for Fiber Weight per Unit Length and Maturity of Cotton Fibers (Array Method) (D 1442 – 52 T). The committee also completed and published as information two proposed methods for "Fineness" of Cotton Fibers by Resistance to Air Flow, the first by the Aeralometer Method and the second by the Micronaire Method.

Adhesives

The many types of properties which it has been found necessary to measure in the proper performance of adhesives have been studied by Committee D-14, and much progress has been reported during the year toward the development of standard test procedures. The methods are in progress on such matters as the nonvolatile content of liquid urea adhesives; additional methods on biological factors; the development of apparatus to measure tack; and a means of measuring storage and working life of adhesives. Research has been accomplished on a test for developing the rate of cure on thermosetting wood glues and on non-destructive testing on glue lines. In the field of specifications,

drafts have been prepared to cover acoustical and binding adhesives.

Engine Antifreeze

A very timely publication on "Selection and Use of Engine Antifreeze" was completed in August by Committee D-15. The purpose of this publication is to provide consumers with practical information and advice on engine cooling system antifreezes and corrosion inhibitors used in antifreezes. The article discusses the various types of antifreeze; it contains information on insulation and servicing of these materials as well as their mixing and their reuse of antifreeze solutions. Other cooling system service products, such as cleaning products and stop leaks are also discussed. Since its appearance, there has been a wide demand for this informative publication which is now in its third printing.

Naval Stores

The work of the newly organized Subcommittee on Specifications resulted this year in the preparation of three proposed specifications which are being published as information only. These cover, respectively, detailed requirements for dipentene, Pine Oil, and Rosin.

The Definitions of Terms Relating to Naval Stores (D 804 – 52) were adopted as standard. Revisions were also made in the Methods of Sampling and Grading Rosin (D 509 – 52), and Test for Toluene Insoluble Solid Matter in Rosin (D 269 – 52).

Soils

The emphasis continues on research in Committee D-18. Two symposiums were presented at the 1952 Annual Meeting on the subjects of shear tests and exchange phenomena. Attention has been given to the development of standard methods for measuring permeability, consolidation, direct shear, triaxial test, California Bearing Ratio, moisture-density relationship, and bearing capacity.

Industrial Water

The Manual on Industrial Water, now being printed, is the outstanding accomplishment of Committee D-19 in 1952. In addition to eight chapters providing a comprehensive coverage of the problems associated with the uses, sampling, and testing of industrial water, there will be appended other useful material including all the current ASTM standards and tentatives in this field.

Among the new and revised methods developed by Committee D-19 in 1952 is Tentative Method for Examination of Water-Formed Deposits by Chemical Microscopy (D 1245 – 52 T) which is of particular significance, being a new type of method.

Plastics

Committee D-20 on Plastics, with other ASTM committees, has taken an active part in international work in the plastics field. The United States has the secretariat for the ISO Technical Committee 61 on Plastics. The work of the secretariat is handled by an American Group under the jurisdiction of Committee D-20. Members of this group attended the first meeting of this international committee held in Turin, Italy, on October 2 to 4, 1952. In addition to the secretariat, the United States holds the chairmanship of the Working Group on Thermal Properties. Considerable progress has been made on this subject.

Several new test methods for plastics were completed during the year. One of these covers the Tentative Methods of Test for Measuring Flow of Thermoplastics by Extrusion Plastometer (D 1238 – 52 T) which determines the "melt index." Another of the new methods was a Test for Resistance of Plastic Films to Extraction by Chemicals (D 1239 – 52 T). Another important new method was the Test for Resistance to Abrasion of Plastic Materials (D 1242 – 52 T). A new test for plasticizers was the Tentative Method of Test for Specific Viscosity of Vinyl Chloride Polymers (D 1243 – 52 T).

Two very important specifications were completed this year. The first covers polyethylene molding and extrusion materials. Since polyethylene is being used widely for many applications, these specifications serve a real need. The other covers the first ASTM purchase specification for plasticizers (D 1249 – 52 T) and covers primary octylphthalate ester plasticizers which provide requirements for three types for use in the compounding of plastics.

Wax Polishes

Performance testing of wax flooring polishes has been the most interesting phase of the work of Committee D-21. Test procedures involving the use of two types of apparatus have been developed for measuring slip resistance. Service life or wear and water spot resistance are two other projects in the field of performance testing which have been under study. Considerable work has been accomplished in the development of test methods on raw materials and on chemical and physical properties. Two proposed methods have been prepared to measure the refractive index of waxes as raw materials and a chemical method of analysis. In addition, four methods are now ready for letter ballot to measure sediment, total ash, nonvolatile content, and kinematic viscosity.

Methods of Testing

Committee E-1 sponsored three symposiums at the 50th Anniversary Meeting of the Society. Two of these were devoted to the subjects of light microscopy, and determination of elastic constants. The latter symposium was arranged as a result of the rapidly increasing use of metals at elevated temperatures in engines of many types and also the use of plastics and of composite materials in aircraft and other structures. Various methods of measurement and their advantages and their limitations were discussed. The third symposium on conditioning and weathering reviewed the many advances in accelerated weathering devices and in new techniques developed in recent years for conditioning and weathering of a variety of materials.

A new Standard Hardness Conversion Table for Nickel and High-Nickel Alloys (E 93 – 52) was completed. This table supplements several existing ASTM hardness conversion tables. Another important addition was a new Method of Test for Diamond Pyramid Hardness of Metallic Materials (E 92 – 52 T).

A number of important changes were made in the Standard Specifications for ASTM Thermometers (E 1 – 52). These included three new ASTM Aniline Point Thermometers graduated in Fahrenheit, a revised Butadiene Boiling Point Range Thermometer, and a new Oil in Wax Thermometer. Also a test gage was included for checking dimensions on enlargements of thermometers.

There has been a need for some years for separate specifications covering hydrometers used in ASTM standards. In response to this need, Committee E-1 completed this year Proposed Specifications for ASTM Hydrometers which are being published as information. These specifications cover API hydrometers which are widely used in the petroleum industry. Requirements are included for the following three types of API Gravity Hydrometers: Plain Hydrometer, Thermo-Hydrometer with Thermometer in Body, and Thermo-Hydrometer with Thermometer in Stem. The specifications also include two types of Soil Hydrometers used entensively in the road material and building construction fields.

Emission Spectroscopy

Committee E-2 continued intensive work on a compilation of Methods for Emission Spectrochemical Analysis and has submitted the last material to be included in this publication. It is expected that the compilation will be available early in the spring.

Metallography

The most significant development in Committee E-4 on Metallography was the publication of a report on the electron microstructure of bainite in steel. This is the second progress report on electron microstructure of steel. Approximately 25 micrographs (light and electron) of transformation products are reproduced. An extremely interesting discussion of the microstructural characteristics peculiar to upper and lower bainite is covered in the 16-page report. Several other papers on electron metallography were given at the 1952 Annual Meeting of the Society, which will appear in the 1952 *Proceedings*.

Fire Tests

Consideration was given by Committee E-5 to the inclusion of fire and hose stream test methods for constructions having fire resistance ratings less than 1 hr in accordance with ASTM Method E 119. Also considered was a small scale test procedure presented by Committee E-6, this proposed method to be an appendix to E 119 and to be specifically used for exploratory tests only. Encouraging progress was reported on the development of a similar size tunnel test method as a modification of the ASTM Method E 84.

Building Constructions

A proposed method of test for strength and stiffness of prefabricated floor and roof constructions for buildings was reviewed by Committee E-6.

Non-Destructive Testing

With the withdrawal in 1948 of the Tentative Methods of Radiographic Testing of Metal Castings (E 15) Committee E-7 began work on a replacement document. After a series of drafts was circulated to all interested parties in the field of radiography for discussion and comments, the Tentative Recommended Practice for Radiographic Testing (E 94) was published in 1952. This document is intended as a guide for satisfactory radiographic practice and discusses equipment, procedure, and recommendations on filing data.

Since the Fiftieth Anniversary Meeting was intended to have an international flavor, Committee E-7 arranged an International Symposium on Non-Destructive Testing. Authors from Denmark, England, Canada, France, Netherlands, Switzerland, Italy, Germany, and the United States participated. These papers and the resulting discussions will be published in a book during 1953.

Mass Spectrometry

Committee E-14 was organized in 1952 to satisfy a growing need for a national organization for coordination, on a broad basis, of work in the field of mass spectrometry. The scope of the new committee is as follows:

Promotion of knowledge and advancement of the art of mass spectrometry by:

(*a*) Coordinating scientific applications and methods of analysis based on mass spectrometry.

(*b*) Sponsoring meetings at which scientific papers relative to mass spectrometry may be presented and discussed.

(*c*) Standardizing nomenclature relating to mass spectrometry.

(*d*) Initiating, sponsoring, and reporting work in the field of mass spectrometry, without prejudice to the jurisdiction of other technical committees over their respective materials.

It is the objective of the committee to encourage participation on the widest possible basis of individuals interested in mass spectrometry, in order to coordinate work and promote the exchange of information in the field. Emphasis will be placed on presentation, at national meetings, of papers on all phases of mass spectrometry, with subsequent publication in the most appropriate medium.

Joint Committee on Chemical Analysis by Powder Diffraction Methods

This year was an eventful one for the Joint Committee on Chemical Analysis by Powder Diffraction Methods. Early in the year, the fourth set of diffraction data cards were published in both the plain and keysort form. This set contains data for approximately 800 materials, including results of the National Bureau of Standards Fellowship work on developing high quality new data and recommendations on data printed in the first three sets. The first, second and third sets became available on IBM cards in 1952 having been published in 1950 on plain and keysort cards.

The Welding of Non-Ferrous Metals

Knowledge of the welding of steel is comparatively easy to acquire, for the subject is well documented and much practical experience has been gained during the past few years. Reliable information on the welding of many non-ferrous metals, however, has been less easy to obtain, and the purpose of this book is to place on record basic information on the application of the various welding processes to the non-ferrous metals.

The author, E. G. West, Technical Director, The Aluminum Development Assn., London, states that the book was written with two main classes of reader in view: the welding engineer, welding operator, welding instructor and trainee, on the one hand; and the designer, works engineer, and metallurgist on the other. An authority in the metallurgical field, Dr. West has been affiliated with ASTM for a number of years as representative of the Aluminum Development Assn.

A list of the Chapters in this book follows: I, "Weldability"; II, "Properties Important in Welding"; III, "Summary of Fusion Welding Process"; IV, "Resistance Welding Processes"; V, "Pressure Welding"; VI, "The Welding of Aluminum and Its Alloys"; VII, "The Welding of Magnesium Alloys"; VIII, "The Welding of Copper and Its Alloys"; IX "The Welding of Nickel and Its Alloys"; X, "The Welding of Lead and Its Alloys"; XI, "The Welding of Zinc and Its Alloys"; XII, "The Welding of Low Melting Point Metals"; XIII, "The Welding of High Melting Point Metals"; and XIV, "The Welding of Precious Metals."

The book is published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Including References and Indices the book consists of 553 pages and the price is $8.50.

American Handbook of Synthetic Textiles

ASTM member Herbert R. Mauersberger, textile authority and President of Textile Book Publishers Inc., has compiled in this volume, with the aid of 20 collaborators, a concise, authoritative, and factual handbook on the production and conversion of all old and new man-made textiles.

The book is designed as a companion work to the author's American Wool Handbook and American Cotton Handbook, following as far as possible the layout and sequence of those publications. It is intended as an American handbook, depicting American practices only.

More than 430 tables, charts, and flowsheets and other illustrations have been employed to aid in simplification of the technical aspects of the material so that even a layman can follow them. The 20 chapters cover such topics as economic and statistical background; preparation and processing of cellulosic fiber; manufacture and processing of nylon and other synthetics; winding, coning, and filling; warping and warp sizing; construction, weaving, dyeing, printing, finishing, and identification of synthetic fabrics. A valuable chapter, Performance Standards for Rayon Fabrics and Proposed Test Methods, contains a number of references to ASTM standards in the synthetic field.

Rounding out the volume is a compilation of all related books and literature references and an appendix containing FTC Trade Practice Rules and tariffs.

Totaling 1217 pages, this handbook is bound in convenient reference size and printed in good size type. Copies can be obtained from Textile Book Publishers Inc., 303 Fifth Ave., New York City, at a cost of $10.80.

Symposium on Gloss Measurement Technical Feature of ASTM Committee Week, March 2–6, 1953

A SYMPOSIUM on Gloss Measurement will feature the technical program of the 1953 Spring Meeting of the Society at the Hotel Statler in Detroit on Wednesday, March 4. The social highlight of Committee Week, extending from March 2–6 in Detroit, will be a cocktail party and dinner arranged by the Detroit District, at which occasion members and guests will hear Dr. Kenneth McFarland, nationally known educator and lecturer.

Scores of meetings of technical committees and their subdivisions have been scheduled for that week in employing the opportunity provided by Committee Week to concentrate meetings in a given time and place with a resulting important saving of travel time and expense.

Details of some of the week's events are given below.

Detroit's Grand Circus Park, showing on the right, Hotel Tuller and across the street, the Hotel Statler—the two cooperating hotels for ASTM Committee Week.

Gloss Measurement Symposium

This Symposium, sponsored by Committee E-12 on Appearance, will be presented in two sessions on March 4. Two papers will comprise the morning session: "Surfaces as Seen and Photographed"; and "The Physics of Surface Reflection." These two papers will deal with the psychological aspects of the problem of gloss measurement and its physics. The problem of bringing these two aspects of gloss measurement together will be discussed in Richard Hunter's paper, "Gloss and Its Measurement," which will open the discusion, at the afternoon session. (This paper appeared in the December issue of the ASTM BULLETIN on page 48.)

Cadillac Square in Detroit with the City Hall in the foreground and Penobscot Building in the background.

The balance of the afternoon session will be devoted to discussion. Deane B. Judd of the National Bureau of Standards will preside at this meeting and will refer questions from the floor to the authors sitting as a panel. Dr. Judd will also provide a summary of the day's activities at the close of the session. *Please note that these papers and their discussions will not be published. All who wish to hear them are cordially invited to attend the sessions.*

Committee E-12 also has under preparation an exhibit in connection with specific gloss problems.

Committee Week

Twenty committees have planned to meet in Detroit during March 2–6 Committee Week at the Statler and Tuller hotels. Members are advised by mail of the details of time and location of meetings of all the committees and subcommittees. As this issue goes to press, the following main committees are scheduled to meet during Committee Week:

B-6 on Die-Casting Metals and Alloys
B-7 on Light Metals and Alloys, Cast and Wrought
C-1 on Cement
C-3 on Chemical-Resistant Mortars
C-7 on Lime
C-8 on Refractories

C-9 on Concrete and Concrete Aggregate
C-11 on Gypsum
C-16 on Thermal Insulating Materials
C-17 on Asbestos-Cement Products
C-18 on Natural Building Stones
D-1 on Paint, Varnish, Lacquer and Related Products
D-4 on Road and Paving Materials
D-8 on Bituminous Waterproofing and Roofing Materials
D-18 on Soils for Engineering Purposes
E-5 on Fire Tests of Materials and Construction
E-7 on Non-Destructive Testing
E-9 on Fatigue
E-10 on Radioactive Isotopes
E-12 on Appearance

Detroit District Hosts at Cocktails and Dinner

FOLLOWING the Symposium on Gloss Measurements in the late afternoon, will be a cocktail party complimentary to those attending the dinner arranged by the Detroit District Council at the Hotel Statler.

The main event of this dinner program will be a talk by Dr. Kenneth McFarland, educational consultant and lecturer for General Motors Corp.

Direct mail notice of the dinner including a reservation form, is being sent to all members. Prompt response in returning the reservations at $6 each will greatly assist the Detroit District in making arrangements.

New List of Eastman Organic Chemicals

A NEW and completely revised edition of the Eastman Organic Chemicals Catalog—including an important new section on the nomenclature of organic chemicals—has just been announced by Distillation Products Industries, a division of the Eastman Kodak Co.

The list, No. 38 in the series published throughout the years, provides detailed information on the more than 3500 organic chemicals supplied by the company together with data on their chemical structure and molecular weight.

Some 256 new chemicals have been added to the Eastman list since the publication of the last catalog, and the names of these are listed in a special section of the new catalog. In addition, special lists in the back of the book group various compounds according to their use or structure. Appearing here for the first time is a group of liquids specially prepared for use as solvents for spectrophotometric analysis in the infrared or ultraviolet.

List No. 38 of Eastman Organic Chemicals is obtainable on request from the Eastman Organic Chemicals Dept., Distillation Products Industries, Rochester 3, New York.

1953 Annual Meeting Symposiums Cover Variety of Fields

THE technical program being developed for the 1953 Annual Meeting of the Society in Atlantic City, June 28–July 3, will again feature a number of symposiums covering a varied group of subjects in the materials field.

Final details of the programs are, of course, not yet available, but the following notes on the various sessions will give a clear idea of the content and nature of the symposiums.

Authors and title of papers in the symposiums and separate technical sessions will appear in subsequent issues of the BULLETIN.

Symposium on Porcelain Enamel

As a result of the survey of industry by Committee C-22 on Porcelain Enamel, a group of sixteen papers was finally selected from a total return of 268 replies containing suggestions for subjects as well as offers of papers. It is pointed out by the committee that the symposium is not in any sense a parallel effort to the work of the Porcelain Enamel Institute and the American Ceramic Society. It is the plan of the committee to interest as many engineers as possible who are not now associated with the porcelain enameling or ceramic coating fields in the standardization work now under way in the Society.

Symposium on Statistical Aspects of Coal Sampling

This symposium, sponsored by Committee D-5 on Coal and Coke, will consist of six papers, the subject matter and data of which have been under discussion for several months by members of the Automatic Sampling Section of Subcommittee XIII on Sampling. This symposium is intended to present Committee D-5's ideas on modern aspects of coal sampling, with special regard to accuracy of the automatic samplers which are increasingly employed by larger power plants, and to application of statistical theory to sampling.

It is expected that not only the American coal industry but many others using bulk sampling will be interested in the subject, especially in the statistical methods which would reduce labor and expense, and improve accuracy. Canada and South African investigators have reported recent work. There is at present a large European group formulating standard methods of sampling in the International Standards Organization. A symposium in this country would accordingly seem most appropriate.

Symposium on Soil Dynamics

The purpose of this symposium, sponsored by Committee D-18 on Soils for Engineering Purposes, is twofold: first, to assemble available information; and second, to discuss the as yet unsolved problems in soils dynamics. The behavior of soil masses when subjected to vibrations and repetitive loading is an extremely important field in the study of soil behavior. It is also one which is becoming more and more important. The committee discussions and special papers on this subject which have already been presented at either subcommittee or main committee meetings have shown both a wide and keen interest in this extremely complicated subject. It is felt this symposium will form an important extension to the data already assembled and will establish a firm beginning which may be extended toward a more complete record of the thinking and work in this field.

Symposium on Lateral Pile Load Tests

The behavior of piles has been one of the most discussed and controversial problems of the entire field of foundation engineering. Subcommittee R-10 of Committee D-18 on Soils for Engineering Purposes has worked diligently for years to overcome the all but insurmountable difficulties of adjusting ideas and requirements for adequate pile loading tests. This work was restricted to the behavior of piles under vertical loading, and the committee succeeded in preparing tentative specifications on this subject.

A topic of extreme interest in this field of practice is the behavior of piles when subjected to lateral loading, and this subcommittee has considered this topic over a long period of time. The present symposium should, because of the scarcity of data relative to this subject, arouse a keen interest in the presentation and discussion of the papers scheduled. It is also the belief that the data presented in this symposium will form a firm basis for later publications for the extension of the thinking and the work on this important topic.

Symposium on X-Ray Spectrographic Analysis

This symposium will consist of four main papers covering basic theory and fundamentals, general aspects of analytical applications of X-ray fluorescence, metallurgical analysis, and analysis of minerals. Prepared discussions will also be presented in this symposium which is being sponsored by Committee E-2 on Emission Spectroscopy.

Symposium on Radioactive Isotopes

Two sessions are contemplated, a morning and evening combination, for this symposium being sponsored by Committee E-10 on Radioactive Isotopes. The morning session will consist of three or four papers which will review the principles, general features, and industrial applications of the use of radioactive isotopes including a discussion of instrumentation, with possibly an instrument demonstration if this can be arranged. The evening session will consist of a movie and possibly a panel discussion.

Symposium on Metallic Materials at Low Temperatures

Five sessions will comprise this symposium being sponsored by the Low-Temperature Panel of the ASTM-ASME Joint Committee on the Effect of Temperature on the Properties of Metals. The sessions titles are as follows: evaluation of engineering failures; criteria for metal behavior and design engineers; mechanical and metallurgical aspects of low-temperatures behavior in ferrous base materials; significance of notch toughness tests; and current research in low-temperature properties.

Symposium on Techniques for Electron Metallography

This program is being organized by Subcommittee XI on Electron Microstructure of Steel of Committee E-4 on Metallography. The objective is to present discussions of current techniques employed in the application of electron microscopy to metallurgical research.

Other Sessions

Committee C-9 is arranging for several concrete sessions, one on the subject of significance of tests of concrete and concrete aggregate. A session of four papers covering filter paper sampling, testing equipment for aerosol, general subject of instrumentation, and dust fall collectors is being sponsored by Committee D-22 on Methods of Atmospheric Sampling and Analysis. The Joint Research Committee on Boiler Feedwater Studies is also sponsoring a session of three papers covering comparisons of automatic and chemical methods for the determination of dissolved oxygen in feedwater, methods for determination of dissolved carbon dioxide and oxygen, and the third paper derives from a task group of Committee D-19 on Industrial Water which conducted a comparative clinic of several methods for determination of dissolved oxygen and will have a report of their results.

NOTES ON PUBLICATIONS

Progress in Evaluation of Crude Rubber Described in New Symposium

THE papers and discussions included in this recently published symposium on Recent Developments in the Evaluation of Natural Rubber were presented at the annual meeting of the Society in New York City, June, 1952. Sponsored by Committee D-11 on Rubber and Rubber-Like Materials, the program was developed by Subcommittee XII on Crude Natural Rubber under the chairmanship of Norman Bekkedahl of the National Bureau of Standards.

The present objective of this subcommittee is to develop and improve methods of physical and chemical testing of crude rubber. Since natural rubber has again become available in world markets such research is urgently needed. The uniformity obtained in the manufacture of synthetic rubber is in marked contrast to the wide variations found in the curing rate and processing characteristics of natural rubber.

The work of the subcommittee and the material presented in this symposium represent part of the effort to meet the need, widely recognized in the industry, for development of standardization of test methods on crude natural rubber.

Included in this symposium, after an introduction by Chairman Bekkedahl, are the following eight papers:

Technical Classification of Crude Natural Rubber—R. G. Newton

Mooney Viscosity Measurements of Technically Classified Rubbers—R. H. Taylor and A. G. Veith

Technically Classified Rubber: The Non-Rubber Content and the Measurement of Cure Rate—A. G. Veith

Vulcanization Characteristics of Natural Rubber—R. D. Stiehler and F. L. Roth

Quantitative Procedures for the Determination of Dirt in Crude Natural Rubber—R. P. Stock, C. O. Miserentino, C. B. McKeown, J. J. Hoesly, R. T. LaPorte, and G. H. Wallace

Preparation of a Standard Natural Rubber—E. M. McColm

Some Aspects of the Testing of Crude Rubber and Crude Rubber Compounds—L. V. Cooper and T. M. Kersker

Rubber Evaluations with an Instron Tester—S. D. Gehman and R. P. Clifford

Copies of this 107-page book can be obtained from ASTM Headquarters. 1916 Race St., Philadelphia, Pa., at a cost of $2.25; price to members, $1.70.

Papers Committee Will Meet in February

THE Administrative Committee on Papers and Publications will meet early in February at which time consideration will be given to the development of the program for the Annual Meeting in June. Quite a number of formal symposiums are in prospect as indicated in the separate article in this issue, and in addition the Papers Committee has a number of offers that have been submitted individually in response to its call for papers. As announced in the call for papers, all offers were to be in the hands of the Papers Committee by January 15. If there is any significant contribution which any member has in mind concerning which he has not advised the Papers Committee, this should be brought immediately to the attention of the Papers Committee in case consideration should be given to such offers.

Rubber Products Compilation in New Edition

THE LATEST edition of ASTM Standards on Rubber Products is now available, offering in compact form all the extensively used methods and specifications developed through the work of ASTM Committee D-11 on Rubber and Rubber-Like Materials.

More than 100 standards appear in this compilation covering such aspects of rubber testing as processibility and general tests; chemical and physical tests of vulcanized rubber; aging,

weathering, low-temperature tests, and electrical tests of rubber; automotive and aeronautical rubber; gasket, hose, packing, belting, and tape materials; electrical protective equipment; rubber-coated fabrics; insulated wire and cable; hard, latex foam, sponge, and expanded cellular rubber; rubber adhesives and latices; nonrigid plastics; nomenclature and definitions.

Appendices include Proposed Methods of Testing Rubber Thread, and personnel and regulations of Committee D-11.

This volume, of more than 600 pages, is bound in heavy paper cover, 6 by 9 in. Copies can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa., for $5; the price to members is $3.75.

Industrial Water Manual Gives Wide Coverage of Data

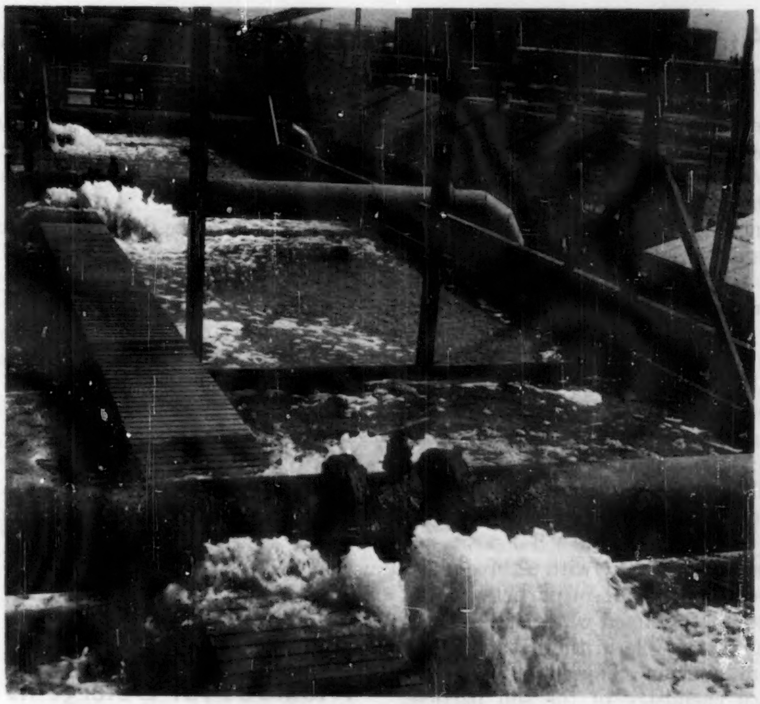
IT HAS long been believed by ASTM Committee D-19 on Industrial Water that something in addition to standard methods of testing was needed by those who look to the Society for technical aid, that a general discussion of the nature and uses of industrial water should illuminate these prescribed procedures and specifications.

The Manual on Industrial Water now off press is intended as a brief reference source of information for three types of users: executives and plant designers; individuals engaged in industrial operations involving the use of water; and analysts, operators of special instruments, engineers, and consultants. It provides basic information for routine use and gives directions into the technical literature. It offers information on the influence of water on industries in which it is used either as a raw material or in conjunction with manufacturing processes, and should serve as a guide to the nature of water planning required at the supervisory and investment levels.

The seven chapters cover: uses of industrial water; difficulties caused by water in industry; composition of industrial water and water-formed deposits; treatment; sampling and analysis of industrial water; sampling and identification of water-formed deposits.

Also included in this Manual are ASTM Standards covering definitions of terms, sampling methods, analytical methods, corrosivity tests, methods of reporting, and general testing methods.

In blue cloth binding, this 375-page Manual can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. List price, $4.25; to members, $3.25.



Industrial Water

Testing of Metal Powders Subject of New Symposium

A SYMPOSIUM on Testing Metal Powders and Metal Powder Products, a feature of the March, 1952, Spring Meeting in Cleveland, has just appeared as a Special Technical Publication.

Sponsored by ASTM Committee B-9 on Metal Powders and Metal Powder Products the Symposium is composed of papers concerned specifically with methods of testing metal powders.

In this field Committee B-9 has developed specifications for types of products where powder metallurgy has been well established as a production method. New applications and improved compositions for known applications have come to the fore in recent years and the task of extending its standardization work to them faces the committee. Several of these new applications and compositions are being discussed in the first group of four papers.

The most important of the metal powder testing methods is the determination of particle size distribution, particularly in the range of subsieve particle sizes. This is a field in which standardization is just beginning. The last three papers are concerned with it.

Titles and authors of the papers following an introduction by Symposium Chairman F. V. Lenel, are:

Test Methods and Devices for Sintered Iron Rotating Bands—J. D. Dale

Quality Control of Metal Powder Gears—W. A. Hinkle

Porous Stainless Steel Compacts for Transpiration Cooling—F. V. Lenel and O. W. Reen

Methods of Testing Cemented Carbide Compositions—A. D. Stevens and J. C. Redmond

Metal Powder Size Distribution by the Roller Air Analyzer—P. S. Roller

Particle Size Determination in Metal Powders—R. P. Seelig

Some Experiences in Specific Surface Measurement by Low Temperature Gas Adsorption—J. B. H. Haertlein, Jr., and J. F. Sachse

Totaling 93 pages, copies of this Symposium can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, at a cost of $2.00; price to members, $1.50.

Philadelphia Hosts at Annual Meeting

THE Philadelphia District which has so often acted as host at annual meetings held in Atlantic City, has again offered its services in forwarding the 1953 meeting in that city in any way possible. The District offered specifically to undertake the duties of host for the week of June 29–July 3, which involve, among other services, phases of the social events of the meeting and the ladies program.

Atomic Science Applied to Soils in New Publication

A HIGHLIGHT of the Society's March, 1952, Spring Meeting in Cleveland, Ohio, was a symposium on Radioactive Isotopes in Soil Investigation held by Committee D-18 on Soils for Engineering Purposes and now appearing as a Special Technical Publication.

A reliable method of determining water content and density of the soil mass is of great significance for in many cases the economic life of a structure can be measured by the supporting power of the soil on which it rests. The strength of the soil is difficult to determine; the soil mass itself is complex and the factors which determine strength are not constant.

In work with natural soil deposits one is dealing essentially with a three-phase system, composed of soil particles, water, and air. Contained water and air play an important role in the nature of this system and, in conjunction with the surface chemistry of the soil particle, lend to the system its capacity for change, introducing the need for applying dynamic analysis methods.

The three papers in this symposium represent research results on apparatus which applies certain phases of atomic science to this vital problem of soil strength analysis. Titles and authors of the papers which appear, are as follows:

Use of Radioactive Material to Measure Soil Moisture and Density—D. J. Belcher, R. C. Herner, T. R. Cuykendall, and H. S. Sack

Radioisotopes and Nuclear Reactors Applied to Soil Mechanics Problems—H. E. Hosticka

Soil Studies Using Nuclear Radiations—D. A. Lane, B. B. Torchinsky, and J. W. T. Spinks

Copies can be purchased from ASTM Headquarters for $1.25; to members 95¢.

The Society Appoints...

Announcement is made of the following appointments of Society representatives

F. H. PENNELL, DeLaval Steam Turbine Co., on ASA Sectional Committee B6 on Gears.

C. E. AMBELANG, Public Service Company of Northern Illinois, on ASA Sectional Committee C-8 on Specifications for Insulated Wires and Cables (Other than Telephone and Telegraph), succeeding H. H. STOUT, Signal Corps., Engineering Labs.

R. A. LORENZINI, American Bitumuls and Asphalt Co., on ASME Boiler Code Subcommittee on the Care of Steam Boilers and Other Pressure Vessels in Service, succeeding MAX HECHT, Adviser, Power Stations Chemistry.

C. F. SCHAUS, General Electric Co., on the Inter-Society Color Council, succeeding F. S. MAPES, General Electric Co.

K. G. MACKENZIE, Vice-President, Texaco Development Corp., has been appointed to succeed C. H. Rose as a Society representative on ASA Standards Council. Mr. Mackenzie is familiar not only with the activities of the ASA by virtue of his chairmanship of Sectional Committee Z11 on Petroleum Products and Lubricants, but also with the activities of the International Organization for Standardization (ISO).

Papers on Statistical Methods for Detergents Published

A FEATURE of the March, 1952, meeting of Committee D-12 on Soaps and Other Detergents, held in New York City, was a Symposium on Statistical Methods for the Detergent Laboratory, just published in book form.

The purpose of this Symposium was to sharpen interest in these useful statistical methods. Laboratory detergency tests have been used for almost a decade but without any exact agreement as to how, and with what soiling media, these tests shall be conducted. It was apparent to the committee that while present methods may lack control or be narrow in scope, a knowledge of the reproducibility and significance of these methods and especially their correlation with practice, is needed.

In these papers, effort was made to present statistical methods in readily understandable terms, using examples from the detergents field for illustration. Following an Introduction by Committee D-12 Chairman Jay C. Harris, these three papers appear:

The Design of Laboratory Control of Laundry Washrooms Based on an Analysis of Variance—G. S. Freeman and M. I. Cohn

The Importance of Correlations in Detergency Testing—J. M. Lambert and E. J. Leshan

Graphical Methods of Statistical Analysis and Tests for Significance—P. L. Schmidt

Copies of this 48-page book are priced at $1.25; to members, 95¢ and they can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa.

Corrosion Short Course at California

A FIVE-day short course in corrosion will be held February 2–6, 1953 at the University of California, Berkeley, Calif. The course is given by the university's extension department and the departments of mechanical engineering, mineral technology, and chemical engineering in cooperation with the National Association of Corrosion Engineers.

Speakers from industrial and governmental laboratories and academic institutions will cover basic corrosion science theory and application of corrosion mitigation measures. Discussion will cover construction materials, coatings, environment, cathodic protection, corrosion testing and evaluation, equipment design, high-temperature oxidation and the role of the corrosion engineer in industry.

Solubility of Carbon in Austenitic Stainless Steel

THE National Bureau of Standards recently made a study, sponsored by the Navy Bureau of Aeronautics, of the solubility of carbon in austenitic stainless steel containing 18 per cent chromium, 10 per cent nickel.

The Bureau investigators found that with a carbon content of 0.0007 per cent, the lowest content studied, solution was substantially complete between 1300 and 1400 F. Solubility appeared to increase approximately linearly from about 1400 to 1975 F, the maximum temperature studied, where carbon solubility was approximately 0.08 per cent. The solubility curve indicates that type 304 extra-low-carbon stainless steel can be effectively annealed at 1700 F but that ordinary type 304 stainless should be annealed at temperatures in excess of 1900 F if the carbon is to be fully dissolved. The study also points up limitations on the effectiveness of attempts to eliminate intergranular embrittlement of austenitic 18 chromium, 10 nickel steel by reducing carbon content.

The use of type 304 ELC steels in industry is based on the premise that the low carbon content (0.03 per cent maximum) will give some protection against intergranular embrittlement. Such embrittlement results when austenitic stainless steels are subjected to temperatures in the range of about 800 to 1400 F and are either simultaneously or subsequently exposed to the action of certain corrodents. Intergranular embrittlement has been ascribed to the precipitation of chromium carbide at the boundaries of the austenite, and it has been proposed that the phenomenon might be completely inhibited by reducing the carbon content to less than the limit of solubility at temperatures to which the steel will be subjected. Although these extra-low-carbon steels have been shown to be less susceptible to intergranular embrittlement than the higher carbon varieties, the NBS study indicates that it is impracticable, if not impossible, to produce steels with carbon contents sufficiently low to insure freedom from carbide precipitation under all conditions of service.

Standards Committee Approves New and Revised Standards from a Number of Committees

At its meeting on December 12, 1952, at ASTM Headquarters, the Administrative Committee on Standards gave its approval to ten new tentative methods and specifications and numerous revisions of existing standards and tentatives. These recommendations came from a broad section of the Society's activities, including Committees on Steel; Wrought Iron; Electrical Heating, Resistance, and Related Alloys; Lime; Thermal Insulating Materials; Gaseous Fuels; Electrical Insulating Materials; Rubber and Rubber-Like Materials; Plastics; and Methods of Testing.

All actions are listed in the accompanying box and the main features of the new and changed standards are described in brief in the following summary.

Steel:

Committee A-1 on Steel proposed deletion of footnote *b* of Table V on Permissible Variations from Theoretical Weights in Tentative Specifications for Billet-Steel (A 15), Rail Steel (A 16), and Axle Steel Bars for Concrete Reinforcement. The footnote which reads, "There is no standard permissible variation over the theoretical weight for individual bars," is no longer applicable to the products produced in accordance with these specifications.

Specification A 15 is also revised with respect to section 3 on Chemical Composition to permit the application of billet stock produced by the open-hearth or electric-furnace rephosphorized processes to the acid-bessemer phosphorus requirement of 0.12 per cent maximum.

Wrought Iron:

Reversion to tentative status of three standard specifications and withdrawal of one standard specification were approved as recommended by Committee A-2 on Wrought Iron.

Standards Specifications for Wrought Iron Plates (A 42) are reverted to tentative status. They were revised in several respects, to bring attention to the deviation of the requirement for yield strength for material over $\frac{3}{4}$ in. thick and to depict accurately in the tolerance tables the true standards of the wrought iron industry. The table for permissible variations of plates ordered to weight is deleted since plate is neither requested nor furnished under these specifications.

Standard Specifications for Staybolt Wrought Iron, Solid (A 84) and Hollow-Rolled (A 86) are revised and reverted to tentative status. The revision clarifies

Actions by the ASTM Committee on Standards, December 12, 1952

All actions listed below were taken on the above date except as noted.

New Tentatives

Methods of:

- Test for Determining Hardness of Contact Materials (B 277 – 52 T)
- Test for Vibration Resistance of Preformed Thermal Insulation for Pipes (C 304 – 52 T)
- Test for Density of Preformed Pipe Covering Type Thermal Insulation (C 302 – 52 T)
- Test for Density of Preformed Block Type Thermal Insulation (C 303 – 52 T)
- Sampling Manufactured Gas (D 1247 – 52 T)
- Test for Resistance to Abrasion of Plastic Materials (D 1242 – 52 T)
- Specific Viscosity of Vinyl Chloride Polymers (D 1243 – 52 T)

Specifications for:

- Polyethylene Molding and Extrusion Materials (D 1248 – 52 T)
- Dioctylphthalate Plasticizers (D 1249 – 52 T)

Recommended Practice for:

- Sublimation Testing by the Electrical Resistance Method (B 278 – 52 T)

Revisions of Tentatives

Methods of:

- Testing Automotive Hydraulic Brake Hose (D 571 – 52 T) (Approved Nov. 13, 1952)
- Test for Compression Fatigue of Vulcanized Rubber (D 623 – 52 T) (Approved Nov. 13, 1952)
- Testing Asphalt Composition Battery Containers (D 639 – 52 T) (Approved Nov. 13, 1952)
- Testing Compression Asbestos Sheet Packing (D 733 – 52 T) (Approved Nov. 13, 1952)
- Testing Rubber-Coated Fabrics (D 751 – 52 T) (Approved Nov. 13, 1952)
- Test for Resistance of Vulcanized Rubber or Synthetic Elastomers to Cut Growth by the Use of the Ross Flexing Machine (D 1052 – 52 T) (Approved Nov. 13, 1952)
- Measuring Low-Temperature Stiffening of Rubber and Rubber-Like Materials by the Gehman Torsional Apparatus (D 1053 – 52 T) (Approved Nov. 13, 1952)
- Verification and Classification of Extensometers (E 83 – 52 T) (Approved Nov. 18, 1952)
- Testing Varnishes Used for Electrical Insulation (D 115 – 52 T)
- Testing Nonrigid Polyvinyl Tubing (D 876 – 52 T)

Specifications for:

- Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (D 735 – 52 T) (Approved Nov. 13, 1952)
- Concentrated, Ammonia Preserved, Creamed and Centrifuged Natural Rubber Latex (D 1076 – 52 T) (Approved Nov. 13, 1952)
- Billet-Steel Bars for Concrete Reinforcement (A 15 – 52 T)
- Rail-Steel Bars for Concrete Reinforcement (A 16 – 52 T)
- Axle-Steel Bars for Concrete Reinforcement (A 160 – 52 T)
- Nonrigid Polyvinyl Tubing (D 922 – 52 T)
- Phenolic Molding Compounds (D 700 – 52 T)

Withdrawal of Standards

Methods of:

- Sampling and Testing Latices of Natural Rubber and Synthetic Rubbers (D 640 – 44) (Approved Nov. 13, 1952)

Specification for:

- Common Iron Bars (A 85 – 36)

Revisions of Standards and Reversion to Tentative

Methods of:

- Test for Resistance of Plastics to Chemical Reagents (D 543 – 52 T)

Specification for:

- Wrought Iron Plates (A 42 – 52 T)
- Staybolt Wrought Iron, Solid (A 84 – 52 T), and Hollow-Rolled (A 86 – 52 T)
- Welded Wrought Iron Pipe (A 72 – 52 T)
- Quicklime and Hydrated Lime for Water Treatment (C 53 – 52 T)

the bend test requirements where there has been some difficulty in interpreting the present wording.

It was found in Standard Specifications for Welded Wrought Iron Pipe (A 72) that the tables covering standard weights and dimensions did not accurately present the true standards of the wrought iron industry. These specifications have therefore been revised and reverted to tentative status to correct these inaccuracies.

Withdrawal of Standard Specifications for Common Iron Bars (A 85) was approved in view of the fact that this material is not being produced.

Electrical Heating, Resistance, and Related Alloys:

Approval was given to a Tentative Method of Test for Determining Hardness of Contact Materials (B 277) developed by Committee B-4 to satisfy the needs of the electrical industry for a hardness test of contact materials. In this method hardness is determined in accordance with the procedure in Standard Methods of Test for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials (E 18) with the addition of requirements referring to the application to contacts.

Approval was also given to a Recommended Practice for Sublimation Testing by the Electrical Resistance Method (B 278) which was much needed in the tube industry. In this method a procedure is described for determining the comparative sublimation characteristics of various metallic materials based upon the measurement of electrical resistance of a sublimed film upon a mica sheet when the material is in the form of cathode tubing or sleeves.

Lime:

Committee C-7 on Lime proposed revision and reversion to tentative of Standard Specifications for Quicklime and Hydrated Lime for Water Treatment (C 53). Changes in this specification were made necessary by new developments in the use of lime in water treating.

Thermal Insulating Materials:

Pipe insulation used aboard ships or in factories near reciprocating engines or turbines is often subjected to considerable vibration which deteriorates the insulation. Recognition of this condition resulted in the development by Committee C-16 of a Tentative Method of Test for Vibration Resistance of Preformed Thermal Insulation for Pipes (C 304). Various amplitudes and frequencies of vibration will produce widely differing stresses in the insulation and, therefore, the results obtained with this test apply only to the specific amplitude, frequency, and specimen used.

Density measurements of preformed pipe covering and preformed block type insulation are useful in determining a product's compliance with specification limits and in providing a relative gage of product weights. Its importance in relation to other physical and mechanical properties such as thermal conductivity, heat capacity, and strength led to the provision of two new methods: Tentative Method of Test for Density of Preformed Pipe-Covering-Type Thermal Insulation (C 302) and Tentative Method of Test for Density of Preformed Block-Type Thermal Insulation (C 303). Both methods described the procedures for determining dimensions and density of these materials as they are defined in ASTM Standard Definitions of Terms Relating to Thermal Insulating Materials (C 168).

Gaseous Fuels:

Recognizing the importance of developing standard methods of sampling, Committee D-3 on Gaseous Fuels delegated the preparation of such methods to a subcommittee formed for this express purpose. One of the results of the work of this group is Tentative Method of Sampling Manufactured Gas (D 1247) describing the procedures involved in securing representative samples of manufactured gas, and correlating the size or type of sample with the analysis to be done subsequently on that sample.

Electrical Insulating Materials:

Revision of Tentative Methods of Testing Varnishes Used for Electrical Insulation (D 115) resulted from a thorough study by Subcommittee I on Insulating Varnishes, Paints, and Lacquers of Committee D-9, of the various test procedures for varnishes in Method D 115 which covers tests for varnishes intended to provide electrical, mechanical, and chemical protection for electrical equipment, including tests for control and performance.

The Committee also proposed several revisions of Tentative Methods of Testing Nonrigid Polyvinyl Tubing (D 876); deletion of the Test for Lengthwise Shrinkage which has been superseded by the Stress Relief Test; clarification of the description of the test specimen for use in the Dielectric Strength Test; and clarification of the procedure in the Wet Dielectric Strength Test which is renamed "Dielectric Strength at High Humidity."

Revision of Tentative Specifications for Nonrigid Polyvinyl Tubing (D 922) provides for inclusion of requirements for a new Grade C covering polyvinyl tubing for high-temperature service. The former requirements were for general purpose polyvinyl tubing which is now designated as Grade A. Designation Grade B is being reserved for a third grade which, it is contemplated, will be added at a later date.

Submitted jointly by Committee D-9 and Committee D-20 on Plastics were revisions of Tentative Specifications for Phenolic Molding Compounds (D 700) in the verbal descriptions of five types of phenolic molding compounds and in requirements for certain physical and electrical properties of seven types of these compounds.

Rubber and Rubber-Like Materials:

Recommendations submitted by Committee D-11 cover revisions of seven tentative methods.

Tentative Methods of Testing Automotive Hydraulic Brake Hose (D 571) are revised to provide for testing $\frac{3}{16}$-in. size hose in addition to the $\frac{1}{8}$ and $\frac{1}{4}$-in. sizes. Provision is also made for use of lower temperature in the specified cold test procedure.

Revision of Tentative Methods of Test for Compression Fatigue of Vulcanized Rubber (D 623) covers use of molded as well as die-cast test specimens in the Goodrich Flexometer test, and clarifies several details of procedure.

A standardized drop-ball impact test for evaluation of asphalt battery containers for resistance to impact shock has been added to the Tentative Methods of Testing Asphalt Composition Battery Containers (D 639). Tests of this sort, results of which are influenced by both container design and material, have been widely used and the standardization worked out in this addition has been very much needed.

A minor change in the Tentative Methods of Testing Compressed Asbestos Sheet Packing (D 733) defines more precisely the rate of load application by the test machine in the tensile strength test.

Another minor revision appears in Tentative Methods of Testing Rubber-Coated Fabrics (D 751) to correct the omission in the adhesion test procedure of the distance of separation of the coating or plies.

Addition of tolerances to the piercing apparatus used in the Tentative Method of Test for Resistance of Vulcanized Rubber or Synthetic Elastomers to Cut Growth by the Use of the Ross Flexing Machine (D 1052) was included to improve the accuracy of the specimen preparation.

The Tentative Method of Measuring Low-Temperature Stiffening of Rubber and Rubber-Like Materials by the Gehman Torsional Apparatus (D 1053) has been revised to improve the torsion wire calibration instructions and to include a new section on calculation of torsional modulus or modulus of rigidity.

The SAE-ASTM Committee on Automotive Rubber recommended to Committee D-11 that there be added to the Tentative Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (D 735) several intermediate grades of rubber compositions to the existing tables and also a complete new table covering polyacrylic rubbers which are resistant to heat and petroleum hydrocarbons. In addition, compression set has been eliminated as a basic requirement in the silicone tables and is to be handled by suffix designation. The committee is also correcting an omission by putting insulated wire and cable compounds in the group of materials excluded from the scope of these specifications.

Revision of the Tentative Specifications and Methods of Test for Concentrated, Ammonia Preserved, Creamed and Centrifuged Natural Rubber Latex (D 1076) incorporates changes in the Mechanical Stability Test requirements which have been worked out in Subcommittee VII and have been under discussion for some time with British technologists through ISO TC/45.

These specifications and methods have superseded the Standard Methods of Sampling and Testing Latices of Natural Rubber and Synthetic Rubbers (D 640) which have accordingly been withdrawn.

Plastics:

Four new methods were proposed by Committee D-20 on Plastics:

A Tentative Method of Test for Resistance to Abrasion of Plastic Materials (D 1242) covers procedures for determining the resistance to abrasion of flat surfaces of plastic materials, measured in terms of volume loss, by two different types of abrasion testing—loose abrasive method and bonded abrasive method. This test was prepared after cooperative laboratory studies, the early work being described in a paper by Gavan, Eby, and Schrader which appeared in the December, 1946, ASTM BULLETIN. It is a companion test to the Tentative Method for Resistance of Transparent Plastics to Surface Abrasion (D 1044) which evaluates surface abrasion by measurement of its optical properties.

The Tentative Method of Test for Specific Viscosity of Vinyl Chloride Polymers (D 1243) was developed after an exhaustive series of cooperative tests by seven laboratories in order to provide a method for characterizing vinyl chloride polymers.

The Tentative Specifications for Polyethylene Molding and Extrusion Materials (D 1248) cover requirements suitable for purchase of polyethylene, one of the most widely used thermoplastic materials. These specifications were prepared after thorough study and discussion of the characteristics and properties of this material which is used extensively in high-frequency electrical insulation such as coaxial cables. Two types are covered: (1) a group of general purpose compounds for molding or extrusion of an unmodified form of polyethylene with or without the addition of colorants as may be required. Three grades are specified, each representative of a different Melt Index range; and (2) a group of dielectric compounds for extrusion consisting of polyethylene resin containing a suitable antioxidant. Three grades are specified, each of which is representative of a range of dielectric quality.

The Tentative Specifications for Dioctyl phthalate Plasticizers (D 1249) is the first in a series of specifications for plasticizers suitable for use in the compounding of plastics. They cover requirements suitable for purchase of three types of primary octyl phthalate ester plasticizers intended for general use.

Committee D-20 also recommended revision of the Standard Method of Test for Resistance of Plastics to Chemical Reagents (D 543). This method of test provides procedures for testing of all organic plastic materials including cast, hot-molded, cold-molded, laminated resinous products, and sheet materials, for resistance to chemical reagents. The test has been carefully reviewed and revised to bring it into line with results of practical experience with the test over the nine years it has been in use.

Methods of Testing:

Committee E-1 has revised the Tentative Methods of Verification and Classification of Extensometers (E 83) to include an Appendix which describes a Quality Control and Calibration Procedure for Wire Strain Gages. It describes the procedure used by the manufacturer of SR-4 strain gages and contains information of interest to the users of this type of strain gage. After further study by the subcommittee responsible for E 83, it is planned to include in the main text of the method, a suitable procedure for calibrating individual wire strain gages. Meanwhile it was considered desirable to make the present information immediately available.

Effect of Tanning on Leather Properties

THE National Bureau of Standards has recently completed a research project on the effects of different tannages on the properties of leather. In this study, sponsored by the Office of the Quartermaster General, leathers tanned with chrome alone were compared with those tanned first with chrome and then retanned with vegetable tannins. Results indicate that each of the two types of leather has certain advantages and that choice of tannage should depend largely on the properties desired in the finished leather.

Both methods of tanning are widely employed in the leather industry. In general, the more rapid chrome tanning is now chiefly used for lighter leathers such as calfskin shoe uppers and kidskins for gloves while the two-step process is used for heavier leathers.

The investigation included physical tests of such properties as tensile strength, stitch tearing, tongue tearing, and bursting strengths. Water resistance and water-vapor permeability were also determined and chemical analyses made for hide substance, grease content, chromic oxide, and ash. Test results showed that vegetable tannins tend to decrease water resistance, reduce strength, and increase thickness. On the other hand, they tend on the whole to make the leather more comfortable for shoes and to increase cutting value.

The Purchasing Department—

. . . Sometimes, it seems to us, the function of the Purchasing Department is the most misunderstood in any industrial company. Salesmen, and perhaps the public generally, often feel that a Purchasing Department is there to drive down prices in a Buyer's market, and to find material at any cost in a Seller's market.

Our Purchasing Department has very broad responsibilities, two of which are of course to find the materials and supplies we need, and to buy them on the most favorable basis obtainable.

But in either a Buyer's or Seller's market, our Purchasing Department is directed to examine quality first, and price second. Further, if material is hard to get and substitutes become the order of the day, purchasing must take the responsibility for establishing the fact that the quality of the substitute is at least equal to the originally specified material.

The quality as well as the selling price of the finished product starts with sound purchasing. Therefore, we combine headquarter's staff and local division purchasing to check and cross-check compliance to specification as well as price.—W. F. Rockwell, Jr., *President*, Rockwell Manufacturing Co.

Properties of Electrodeposited Nickel

THE EFFECT of plating variables on the structure and properties of electrodeposited nickel has been the subject of comprehensive laboratory investigation by the National Bureau of Standards.

In the course of the study which was sponsored by the American Electroplaters' Society, cathode current efficiencies and the internal stress of the deposits were determined for a great number of different bath compositions and operating conditions; the chemical composition and microstructure of the deposits were investigated, and their thermal and mechanical properties measured.

The results show that hardness, tensile strength, and other properties of nickel deposits can be varied over a wide range by proper choice of plating bath. Moreover, it has been possible to explain this broad variation in properties on the basis of the physical nature of codeposited impurities present in small amounts.

The NBS investigation provided a large amount of basic data which can now be utilized for consistent production of deposits having desired properties. It showed that the most important factor affecting the properties of the deposits is the type of plating solution, that is, the nature of the anion and the presence of special additives.

What We Have Learned in 1952

A Report to the Joint Meeting of Standards Council and Board of Directors of ASA

By J. R. Townsend[1]

The most challenging problem of modern times is the transmission of information. Advances in technology pyramid on the information derived from the experience of the past. This presents the staggering spectacle that our technical information is expanding with explosive force. Advances in technology must not only take cognizance of the most recent discoveries and new information but this knowledge must be used in full recognition of all previous knowledge and experience if a wholly satisfactory result is to be achieved.

Nowhere does this problem become more important than in defense planning. This problem would be hopeless of solution if it were not for the recognition of the value of standards. Standards represent an accord of those best informed as to the best methods of utilization of technical information applying to particular situations and uses. Standards represent the best thought in any given field of activity if they are up to date and under the surveillance of an active group or committee. The concept of standards I wish to present to you is not a static one but should in its best expression be dynamic. By this I mean there must be a clear distinction between the objectives of the designer and the one who uses technological information, and of those who review and correlate technical information so that it may be applicable in the form of standards. In other words, the engineer, the scientist, and the standards specialist should be always alert and prepared to provide new and sharper tools in the form of standards for the design engineer.

A corollary to this problem of providing sources of information is the problem of economy of time. No designer can be fully familiar with all the resources of technical knowledge available to him. Much of this is compressed and is available and epitomized in the form of standard specifications for materials, processes, methods of test, components, and end items. They are such that he may utilize them in confidence in developing his design. It is a special province of engineering to apply this information expertly and expeditiously; in fact, this is the only known method of proceeding from initial design conception to manufacturing information that is direct and wholly reliable. Standards therefore provide us with an economy of engineering talent at a time when engineering personnel is most scarce.

We recognize, therefore, that the use of standards in this dynamic way is an important basic essential to our present complicated technical civilization. In the coming years, this subject will assume increasing importance. In the military field in World War I, American quantity production had an important bearing on the outcome. In world War II our production facilities improved and we learned the techniques of introducing improvements in design without interfering with production. This made possible our weapons being constantly modernized with loss in production.

The next challenge that faces us with respect to a third world war would be the most expeditious utilization of new scientific knowledge in design and I wish to submit to you the thought that in view of the complications involved, this new science can only be applied with full recognition of that which has gone before. Standards in the dynamic sense that I am emphasizing here then become equal in importance to the utilization of the new science.

This general thought has been recognized by the Department of Defense, specifically by the Munitions board. Two public laws H.R.-4574 and S-3959 set up a Federal Supply Service which replaces the Federal Specification Board and this Service under the General Services Administration has been awarded the problem of coordinating Federal specifications. The Department of Defense has made an agreement with the General Services Administration and this is noted in a memorandum dated Nov. 7, 1951, which states, "When the requirements are essentially similar to those contained in a nationally recognized standard, an appropriate note to this effect should be included in the specification or standard." Further, directive 4000.8 covering military supply requirements, signed by Secretary of Defense Lovett, includes a statement, "Commerical specifications and standards when practical and economical will be adopted and integrated in the military specifications and standard systems." The Defense Supply Management Agency order No. 1-C signed by Rear Admiral J. W. Fowler carries the instruction to "Coordinate the military participation in standardization efforts of industry, technical societies and associations nationally and internationally and effect necessary coordination and assistance of governmental and industrial activities or agencies relative to material standardization within the Department of Defense."

Two thoughts are brought out by these directives: first, the importance of utilization by Government agencies of industrial specifications and, second, the recognition of the fact that Government people should cooperate in the preparation of these standards.

The ASA occupies the key position in the field of standards on a national and international basis. Whereas the ASA does not draft nor generate specifications it recognizes by the consensus principal standards submitted by its sponsor membership and by sponsor organizations outside its membership. These standards are proposed by three different methods: Existing Standards Method, General Acceptance Method, and the Proprietary Method. The Existing Standards Method is one in which a standard already in existence may be submitted for approval by any responsible body and approved by the Association provided it is shown that the proposed standard is supported by consensus of those substantially concerned with it. The General Acceptance Method is recognized as a suitable method of producing a standard by conference, and this usually refers to simple projects, the standard so produced coming to ASA from the conference for approval. The Proprietary Method relates to a responsible body having a position of pre-eminent importance in the field of the standard and being given responsibility for revisions of specific standards previously approved by ASA.

The relationship, therefore, of ASA with its member bodies and other national bodies is extremely important. In this connection we are particularly mindful of the importance of having

[1] Director of Materials and Standards Engineering, Sandia Corp.; also Chairman, Standards Council, American Standards Assn.

ASTM Standards accorded approval as American Standards in order to increase their stature in the eyes of the Government personnel concerned with accepting industrial standards for Federal use both military and civil. At the present time there are 1900 current ASTM Standards; some 500 of these have been approved as American Standards but of these approval has lapsed on 270 since they are being revised or else the ASTM has accepted superseding standards.

The foregoing situation was discussed at a joint conference between the ASA and the ASTM on October 15 and it was recommended that the ASTM Administrative Committee on Standards also function as a Correlating Committee of ASA for consideration of any standards developed by ASTM and submitted for approval as American Standards. Such a procedure would tend to coordinate the procedures of ASTM and ASA, improve the form of submittals, speed up the approval process and encourage the submittal of more ASTM Standards for approval as American Standards. Standards cleared by this Correlating Committee can then go directly to the Board of Review of ASA for approval as "American Standard." It was felt at this meeting that this proposal might go a long way in solving a major problem of expediting the approval of standards.

This proposal will be presented to the Committee on Procedure and to the Miscellaneous Projects Correlating Committee of ASA and will be given consideration by the Staff and by the Administrative Committee on Standards of ASTM. It is felt there is no need for amending the Constitution, By-laws or Procedures of ASA since the establishment of additional Correlating Committees, as herewith described, is within the function of Standards Council. The prestige of ASTM Standards is very high. However, their approval as American Standards will emphasize to civil and military Government groups the availability of this body of standards for Government use.

This situation is not one peculiar to ASTM. Government has done its part in issuing the necessary directives. Industry must do its part and see that the standards which it develops receive nationwide acceptance, by clearance through ASA, such that Government without hesitation will make reference to them, or directly adopt them instead of developing new standards. This means that member bodies in general must more and more bring standards to ASA for approval.

At the meeting of Standards Council on April 18 a resolution was passed unanimously inviting all Government departments and agencies, which were formerly members of Standards Council, to attend all future meetings of Council with the privileges of the floor. At the September 16 meeting of Standards Council in Chicago, it was my privilege to announce that eleven departments of the Government had accepted this invitation. We propose to proceed along these lines and any others which we can find to weld the interests of Government and industry into a consistent whole. The safety and economic future of the country demand it.

The revised Federal Charter which will be brought before the 83rd Congress is so drawn as to admit the cooperation of government agencies in the operations of ASA.

As further evidence of the necessity for such a coordination of effort, it should be pointed out that there just isn't sufficient technical personnel available to develop all the standards needed working separately, to keep in step with the technological advances being made. This means that everyone must be willing to contribute of his experience for the benefit of the whole. Standards of companies and whole industries must be made available to others. In other words, there must be a pooling of effort. ASA procedures provide a mechanism whereby this can be done in such a way that no group need lose its own initiative or freedom of decision. Everyone gets his day in court.

In working along these lines it is our belief and hope that this thorough-going cooperation on industrial standards and the utilization of such standards by the national government will go a long way in improving the industrial life of the nation and our preparedness in times of national emergency.

This is what we have learned in 1952.

Battelle in Europe

THE cornerstone for a new research center at Frankfurt, Germany, to serve the industry of that country, was laid October 31. The new Battelle Memorial Institute for Germany is being established by Battelle Memorial Institute, American research foundation at Columbus, Ohio.

Battelle is establishing another research center at Geneva, Switzerland, and has set up a program of fellowships for selected students in the universities of both Switzerland and Germany.

The Frankfurt research center will engage in chemical, metallurgical, and engineering research. It is already under construction on a site presented for the purpose by the City of Frankfurt and it is expected that the laboratories will be completed for occupancy by late spring of 1953.

Use of ASTM Standards

THERE are many indications of the continuing widespread application of ASTM specifications and test methods. They are of service in many different ways, not only in the procurement of materials, but in the technical data in which is incorporated just what the engineer and designer may need as an authoritative answer to some problem.

It was gratifying to the Executive Secretary in his recent Southwest and West Coast Trip to find various evidences of the interest in ASTM publications and especially in the standards. Short visits to reference departments of libraries in such centers as Houston, Los Angeles, and San Francisco show that the Book of ASTM Standards occupies a prominent place in the reference file. Reference librarians always comment on the constant use of these Books.

In visiting a number of members in the Far West he frequently found ASTM publications open and being referred to on the member's desks and in the classroom. It should afford the hard-working committee members gratification to realize that the considerable amount of time devoted to the committee work eventually pays off in standards and data which are of great benefit to industry and Government in their respective fields concerned with materials.

E. H. Sargent Celebrates 100th Anniversary

A SPECIAL 100th anniversary issue of the Sargent quarterly "Scientific Apparatus and Methods," is devoted to an informal history of the Sargent firm. Of particular interest is the description of the historical atmosphere in which the organization had its genesis. Chicago, in 1852, with its immense vitality and excitement proved a fortuitous site. In the course of the eventful history a wide range of subjects are touched upon: the gold rush, the formation of the Chicago College of Pharmacy, and Illinois College of Pharmacy (in both organizations E. H. Sargent was active), the great fire, St. Luke's Hospital in Chicago (Sargent and his wife served as trustee and member of the board of directors, respectively), and much later the first and second World Wars. Biographical material on each of the four presidents of the firm from E. H. Sargent to the present president, Thomas M. Mints, is included. Mr. Mints serves on subcomittees 19 and 21 of ASTM Committee E-1 on Methods of Testing.

ASTM Bulletin

JANUARY 1953

NO. 187

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Membership Over 7300; Members' Aid Appreciated

WITH a net gain in 1952 of 269 new members, the Society's membership, as of December 31, 1952, totaled 7342, classified as follows:

Honorary	21
Perpetuity and Life	11
Sustaining	265
Company (including Trade Associations)	1767
Indivudual (including Institutions, Scientific Associations, and Government Departments)	5169
Junior (under 27 years)	109

In addition, approximately 500 students in engineering schools throughout the country were enrolled as ASTM student members.

Although the 1952 net gain (269) is a few (7) under the previous year's figure, it has been gratifying to record fewer 1952 resignations (25 less than in 1951, and 87 less than in 1950)—and the Membership Committee of the Board of Directors, which has membership matters and trends under constant scrutiny, recognizes the 1952 increase as a healthy and normal growth.

Actually the names of 93 new companies and 551 individuals were added to our rolls the past year, but deaths, resignations, and other losses took the usual toll from the gross figure.

Much of the credit for the steadfast and continuing growth of the Society should go to our current members who in large measure are responsible for maintaining the organization on even keel through their interest, support, and recommendation of membership prospects.

In the maintenance of the Society's expanding technical activities the income from membership dues necessarily plays an important part, and of especial significance in this respect is the support of our sustaining members. This class, established in 1930, now embraces 265 company members who by transfer of their corporate affiliation to the sustaining type have taken advantage of the incentives offered sustaining members including very liberal publication privileges, and at the same time, through the annual dues of $150, aid substantially in underwriting the work of the Society, so significant in the various fields of industry.

The Directors serving on the Membership Committee, and in fact all officers of the Society, are sincerely appreciative of the interest and activity of all ASTM members, and anticipate the continuing support of our members in 1953—hopeful that this new year will show even greater increases in all classes of affiliation.

Thank-You Note from Executive Secretary and Associate Executive Secretary

MANY notes and messages of congratulations and best wishes have been received by the new Executive Secretary and Associate Executive Secretary. Messrs. Painter and Hess wish to express their appreciation to the many members and friends who have written. It is of interest that many of the notes incorporated the theme "you can count on my continued support and be sure to call on me if I can be of service in any way."

It is a source of gratification and an inspiration to be associated with the men who constitute ASTM.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and locations of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
January 26–28	D-19 on Industrial Water	St. Louis, Mo.
January 29–30	B-4 on Electrical Heating, Resistance, and Related Alloys	New York, N. Y.
February 1–6	D-2 on Petroleum	Cleveland, Ohio
February 3–5	A-1 on Steel	Birmingham, Ala.
February 3	District Meeting, Committee A-1 on Steel, Birmingham Sections, American Chemical Society, and American Society for Metals	Birmingham, Ala.
February 13	Philadelphia District (National Officers' Night)	Philadelphia, Pa.
February 20	D-6 on Paper and Paper Products	New York, N. Y.
March 2–6	ASTM SPRING MEETING AND COMMITTEE WEEK	Detroit, Mich.
March 3–5	Technical Papers on Mass Spectrometry	Pittsburgh, Pa.
March 3	E-14 on Mass Spectrometry	Pittsburgh, Pa.
March 4	E-13 on Absorption Spectroscopy	Pittsburgh, Pa.
March 5–6	E-2 on Emission Spectroscopy	Pittsburgh, Pa.
March 16–17	D-12 on Soaps and Other Detergents	New York, N. Y.
March 17	D-7 on Wood	Chicago, Ill.
March 17	Philadelphia District	Philadelphia, Pa.
March 17–18	B-5 on Copper and Copper Alloys	New York, N.Y.
March 18–20	D-13 on Textile Materials	New York, N. Y.
March 23–25	D-20 on Plastics	Pocono Manor, Pa.
March 25–27	D-9 on Electrical Insulating Materials	Pocono Manor, Pa.
April	C-19 on Structural Sandwich Construction	Dallas, Tex.
April 9–10	D-14 on Adhesives	Cincinnati, Ohio
June 29–July 3	ASTM ANNUAL MEETING	Atlantic City, N. J.

DISTRICT ACTIVITIES

California Districts Hear Dr. McMaster on Non-Destructive Testing

Speakers Table at San Francisco Meeting. Left to right: R. Johnston, Chairman, Northern California Section, ASM; P. V. Garin, Chairman, ASTM Northern California District; R. C. McMaster; ASTM Executive Secretary, R. J. Painter; and G. H. Thurston, Chairman SNDT Northern California Section.

At well-attended meetings in Los Angeles (Southern California) and San Francisco (Northern California), in each case held with the local chapters of the Society for Non-Destructive Testing, Dr. R. C. McMaster, Battelle Memorial Institute, gave a somewhat modified and condensed version of his notable 1952 Edgar Marburg Lecture on "Non-Destructive Testing." At the Los Angeles meeting held at Rodger Young Auditorium on November 18, he made use of a large number of illustrations showing practical applications of various kinds of non-destructive testing including radiographic, ultrasonic, and many others. There were about 250 present at this meeting. Some of those at the speakers' table are shown in the accompanying photograph.

At the San Francisco meeting at St. Julien's Restaurant where there were about 140 in attendance, Dr. McMaster condensed his lecture somewhat. In his interesting introduction he pointed out that everyone through his senses is carrying out non-destructive tests. He noted, too, that a one billion dollar (at least) industry—coin operated vending equipment—leaned heavily on non-destructive tests. In these machines various types of measuring, weighing, and testing devices operate quickly to turn back defective or illegal coins.

He had a series of interesting slides showing how radiographs can aid in perfecting welding of aluminum. A relatively new technique being developed to use low-cost film was described. Mass production methods were noted. He cited some costs, for example, in the case of oil well tubing, which would be fully justified to prevent failures in the drilling operation where great time and expense would be involved replacing material which failed far below the surface. The accompanying photograph shows some of the ASTM and SNDT officers present. Dr. McMaster is the current President of the Society for Non-Destructive Testing.

At both meetings ASTM Executive Secretary R. J. Painter spoke briefly, expressing appreciation to Dr. McMaster and to Battelle for making the West Coast journey possible. He advised that the 1952 Lecture by Dr. McMaster was to be published both separately and in the 1952 *Proceedings*, and also cited some of the work of Committee E-7 on Non-Destructive Testing, including several symposiums beginning with the notable 1935 Volume on Radiography, and more recent ones covering the "Role of Non-Destructive Testing in the Economics of Production" *STP 112*, and "Ultrasonic Testing."

In each district the officers handled the details of the meeting cooperating with the local SNDT officers. Chairman E. O. Bergman, C. F. Braun and Co., presided in Southern California, with the speaker introduced by the SNDT Chairman Robert Reynolds, Lockheed Aircraft Corp. Secretary M. B. Niesley, California Testing Labs., Inc., had handled preliminary arrangements, and his associate, Phil

Some of the 140 guests at the Northern California District Meeting

R. C. McMaster

Among members and guests present at the Southern California District Meeting in Los Angeles were, counterclockwise: John M. Clemons, Ferro-Spec Laboratories; Ned Trahan, Ferro-Spec Labs.; Bruce Sutherland, E. I. du Pont de Nemours & Co., Vince Atchison, Ferro-Spec Labs.; Leonard Garcia, Ferro-Spec Labs; Jack Morse, Ferro-Spec Labs.; Phil Lorner, Ferro-Spec Labs.; Jim Simpkin, Ferro-Spec Labs.; B. R. Dunham, Southwestern Cement; Felix S. McGinnis, Jr., Southwestern Cement; J. B. Alexander, Southwestern Cement; Bob Sinclair, General Electric; George W. Woods, Advance X-Ray; Willard Cox, General Electric; C. F. Muencin, Ferro-Spec Labs.

The ladies' table at Southern California District Meeting.

Among the 250 guests at the Southern California meeting were, counterclockwise, James C. Judge, Dow Chemical Co.; Francis Lyle, Dow Chemical; Walt Larson, Dow Chemical; P. J. Rich, Kwikset Locks; Paul E. Bruce, Kwikset Locks; Robert H. Falk, Kwikset Locks; Sam L. Haley, Metal Control Labs.; Howard E. Pellett, Metal Control Labs; John Delmonte, Furane Plastics; John J. Knudsen, Furane Plastics; John A. Gettys, Picker X-Ray; Clair Baker, Pacific Tube; R. D. Westphal, General Electric; H. G. Landstrom, Fluor Corp.

Grimes followed through at the meeting in Mr. Niesley's absence. Vice-Chairman J. B. Morey, The International Nickel Co., Inc., aided his fellow officers. In Northern California, details were handled by H. P. Hoopes, Pabco Products, Inc., Vice-Chairman, working closely with Chairman P. V. Garin, Southern Pacific Co., and Secretary P. E. McCoy, American Bitumuls and Asphalt Co.

An innovation at the Los Angeles meeting was the presence of a number of ladies, wives of district officers and members.

There were many favorable comments on Dr. McMaster's presentations and also on the excellent way in which the two local groups had cooperated in assuring the success of the affair.

District Council Meetings:

On Monday night, November 17, the Southern California District Council had a very well-attended meeting—in fact, almost 100 per cent—with several guests, including F. G. Tatnall, Philadelphia, and the Executive Secretary, R. J. Painter. It is of interest that among those present as Council Members were Past-Chairmen W. C. Hanna, California Portland Cement Co.; E. O. Slater, Smith-Emery Co.; R. B. Stringfield, Consulting Chemical Engineer; C. E. Emmons, The Texas Company; C. M. Wakeman, City of Los Angeles Harbor Department, these men having headed the Council continuously since 1943. Former Vice-Chairman F. J. Converse, California Institute of Technology, was in attendance too.

The current and some of the former officers of the Northern California District also had a luncheon meeting preceding its technical meeting, among those present being Theodore P. Dresser, Jr., Abbot A. Hanks, Inc.; Dozier Finley, Pabco Products, Inc., former chairman, who headed the committee for the 1949 Pacific Area Meeting in San Francisco, and L. A. O'Leary, W. P. Fuller and Co., immediate past-chairman.

At these council meetings plans were made for the Spring visit of the ASTM President, H. L. Maxwell, who will speak at a joint meeting of the American Chemical Society in Berkeley, on March 9, and in Los Angeles on March 12. Full details of these two meetings will be given all the district members.

As indicated in a separate article, the 1955 Second Pacific Area National Meeting was the main subject considered. This will have the enthusiastic support of both Councils. While Tentative dates for the meeting had been selected in the Fall of 1955, there is likelihood that a change will be made, perhaps to 1956.

Two Winter Meetings Scheduled at Philadelphia and Birmingham

President Maxwell to Speak

REGIONAL meetings scheduled in Philadelphia and Birmingham early in February merit particular attention.

The Philadelphia District Council has announced that it has scheduled a "President's Night" Feb. 13, 1953, at the Franklin Institute, Philadelphia, Pa. President Harold L. Maxwell's address on "Chemical Developments and Engineering Materials" will be preceded by a tour of the Institute.

A particular effort is being made to secure the attendance of engineering and technical students in the Philadelphia area. The occasion will provide an opportunity for the students and others attending the meeting to talk informally with Dr. Maxwell. Light refreshments will be served after the session. Although no formal dinner is planned in connection with the session, members and guests are being asked to advise E. K. Spring, Henry Disston and Sons, Inc., Unruh and Milnor Sts., Tacony, Philadelphia 35, Pa., as to whether they will be attending the lecture, tour, or both.

Dr. Maxwell's service on the faculty of Purdue University for a number of years and his extensive industrial experience involving not only engineering materials and problems, but also personnel decisions, give him a particularly appropriate background to address the engineering students in the Philadelphia area.

Birmingham Meeting:

In conjunction with the three-day meetings of ASTM Committee A-1 on Steel, a technical session is planned for February 3 in the Tutwiler Hotel in Birmingham, Ala. A dinner in the Terrace Room is scheduled for 6:30, and, following the dinner, Dr. Maxwell will speak on the subject "Chemical Developments and Engineering Materials." This session is under the joint sponsorship of Committee A-1, the Birmingham Chapter of the American Chemical Society, and the Birmingham Chapter of the American Society for Metals. National officers of the Society will be present. Dinner reservations should be sent to J. R. Trimble, Manager, Department of Metallurgy, Inspection and Research, Tennessee Coal and Iron Div., United States Steel Co., Box 599, Fairfield, Ala.

All ASTM members in Alabama are being urged to attend this meeting and meet President Maxwell and the other Society officers. This is the first ASTM technical meeting in Birmingham where there are numerous ASTM members. Some of the members in the area did meet with the Assistant Secretary and later another group met with the Executive Secretary a few years ago. This will be the first meeting of Committee A-1 in the South, normally the early Spring sessions of this committee being held in Philadelphia or Pittsburgh.

Norman L. Mochel, Vice-President of ASTM and Chairman of Committee A-1, will address a luncheon of the Birmingham Rotary Club on Wednesday, February 4.

Houston Members Meet to Discuss New District

ABOUT twenty members and committee members of the Society met at the Hotel Warwick in Houston, Tex., on November 25 during a visit of Executive Secretary Painter, to discuss formation of a new ASTM District in that general area of Texas. The largest concentration of members is in the Houston area, but there are sizable groups in Dallas, Fort Worth, Austin, and other cities not too far distant from Houston.

A decision was reached to proceed with the organization of the new district in line with the Society's charter for districts. This provides for the appointment of Councilors *pro tem* and an acting Chairman, following which formal nominations and elections are held in the area covered.

Two years ago, Mr. Painter, then Assistant Secretary, had a luncheon meeting in Houston with a number of members, and in the Spring of 1951 Mr. Warwick arranged for a get-together of Houston members. Meanwhile, the membership in the area has increased and there is considerably more interest in the technical committee work of the Society. The whole area is one of bustling industrial activity, and it is felt that formation of a district will have numerous benefits.

Among those present at the recent meeting were J. R. Trimble, Tennessee Coal and Iron Div., United States Steel Co., a Director of the Society, who accompanied the Executive Secretary, and W. Mack Crook, Consulting Engineer and President of the Houston

To ASTM Members: Your help is needed in maintaining that constant increase in ASTM Membership

To the ASTM Committee on Membership,
1916 Race St., Philadelphia, 3, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below:

____

____

This company or individual is interested in the following subjects: indicate field of activity, that is, petroleum, steels, non-ferrous, etc.

____

Signed____________________

Date____________________ **Address**____________________

Technical Societies Council. This latter organization of affiliated local sections and chapters has been carrying out effective coordinating work and is responsible for other activities in Houston.

A group of three members assisted in arrangements for the dinner meeting; M. E. Holmberg, Metallurgical Consultant; C. S. Wilson, Engineer of Tests, Texas and New Orleans Railroad Co.; and William G. Hall, Assistant Chief Chemist, Shell Chemical Corp. Other ASTM members and men active on technical committees who were present included: R. P. Daniels, Gulf Oil Corp.; C. H. Bone, Sheffield Steel Corp.; E. S. Dixon, Consultant; H. W. Bennett, Sheffield Steel Corp.; T. C. Tweedie; C. E. Lauer, The Texas Company; C. F. Lewis, Cook Heat Treating Co.; D. E. Wilson, Cameron Iron Works; E. E. Berkley, Anderson, Clayton & Co.; G. R. King, Hughes Tool Co.; J. B. Baird, Southwestern Labs.; O. R. Shorman, Pittsburgh Testing Lab.; and Mr. Bryan, representing Herbert M. Shilstone of Shilstone Testing Laboratory.

Discussion at the meeting resulted in a consensus that the entire states of Texas, Oklahoma, and Louisiana, and that portion of Arkansas not in the St. Louis District, should be covered. This is in line with the policy of having each district cover a rather widespread area and in making them contiguous insofar as possible.

Rubber—Topic of New York District Meeting

On December 8 about 70 members, committee members, and visitors in the New York District heard two very interesting talks on the general subject of rubber. Gerald Reinsmith, Chief of the non-Metallic Structural Materials Unit, Army Ordnance Corps, talked on "Army Ordnance Rubber Goods," and G. C. Massen, Director of the Rubber Laboratory, R. T. Vanderbilt Co., reviewed activities of ASTM Committee D-11 on Rubber and Rubber-Like Materials. The meeting was arranged by Sherman R. Doner, Raybestos-Manhattan, Inc., for the New York District Council.

ASTM President Harold L. Maxwell, extended greetings in the name of the Society and expressed appreciation for the activities of the New York Group. Executive Secretary R. J. Painter also spoke briefly, noting that the meeting was another example of cooperative effort, in this case arranged by the New York Council but covering the work of ASTM through Committee D-11 in the rubber field.

Mr. Massen noted that it was just 40 years ago that Committee D-11 had been organized by a handful of then active men. Now there are over 200 voting members and many others participating in the work. He showed in an interesting way how the group operated and mentioned some of the problems on which it is working, using the subcommittee structure as an outline. He particularly stressed some of the cooperative efforts with other groups.

Mr. Reinsmith's paper was of much interest, covering as it did an outline of the Department of Defense and how the Army group functions with respect to rubber products. There were numerous illustrations and a special exhibit.

The New York District Chairman, G. O. Hiers, opened the meeting and Mr. Doner introduced the speakers.

Ohio Valley District Sponsors Meeting in Dayton

Following the recent District practice of sponsoring meetings at various centers, the Ohio Valley District organized a meeting in the Dayton area on the evening of November 20, taking advantage of the fact that a number of members of the Board were visiting the Wright Air Development Center in Dayton. The principal speaker was Past-President L. J. Markwardt, who was one of those participating in the visit. Mr. Markwardt gave a most informative and interesting talk on "Wood as An Engineering Material." The meeting was held at the Frigidaire Auditorium at Moraine City and was attended by guests from a widespread area.

J. C. Pitzer, District Chairman, introduced the members of the Board—Vice-President N. L. Mochel, Westinghouse Electric Corp.; Director R. A. Schatzel, Rome Cable Corp.; and then called upon the Senior Vice-President L. C. Beard, Jr., Socony-Vacuum Oil Co., for comments. He also introduced the Associate Executive Secretary, R. E. Hess.

Arrangements for the meeting were made by Mr. Pitzer, with R. S. Armstrong, Standard Oil Co., Vice-Chairman, and Archibald Hurtgen, Henry Vogt Machine Co., Secretary, cooperating. J. C. Harris, Monsanto Chemical Co., active member of the District, and former officer, made the detailed arrangements for the meeting.

To ASTM Nonmembers: The Society welcomes inquiries on the "Advantages of Membership"

To the ASTM Committee on Membership
1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on Membership in ASTM and include a membership application blank.

Signed____________________

Address____________________

Date____________________

Review of Major Research Activities

EDITOR'S NOTE.—This article continues the summary of ASTM research work which was begun in the December 1952 ASTM BULLETIN. Work in cementitious and miscellaneous materials is reported here and will be concluded in the February issue.

COMMITTEE C-1 ON CEMENT

Blended Cements.—Two series of cooperative tests are concerned with the development of (*a*) a method for evaluating pozzolanic materials and (*b*) a reliable method for measuring the fineness of these materials. Results of tests by five laboratories on 20 samples of fly ash are currently being analyzed for developing a specification on this material and for portland-fly ash. A symposium on the use of these materials was held in 1949 (*STP No. 99*).

Masonry Cement.—An investigation was started in 1947 designed to secure data to assist in writing a durability specification for masonry cement. A second series of tests was begun in 1948. These tests resulted in revisions of specifications for masonry cement (C 91) and for natural cement (C 10). Efforts are currently being directed toward the improvement of methods of testing the natural cement for strength and autoclave expansion. The inclusion of an expansion limit in the specification for masonry cement, based on autoclave tests, is now being considered.

Additions.—A study in 1942 resulted in a tentative specification for air entraining portland cement (C 175). Grinding aid materials have been tested and included in the specifications for portland cement (C 150). Studies of various additions to cement have been continued, including the study of air entraining additions. Further studies have resulted in a specification for air entraining additions (C 226).

Bleeding, Plasticity, and Workability.—The committee has sponsored a series of cooperative tests among a group of laboratories to study the bleeding of cements using the methods described in a paper presented by R. C. Valore, J. C. Bowling, and R. L. Blaine at the 1949 Annual Meeting. The Method for Measuring the Bleeding of Cement Pastes and Mortars (C 243) was based on these data. Further cooperative work is proceeding on refinement of the method.

Particle Size and Specific Surface.—Thirty brands of portland cement were tested by the air permeability method and also by the turbidimeter method and the results were made available to the Sponsoring Committee on portland cement. Details of these two methods for determining fineness have been studied and cooperative tests have been planned to resolve certain questions, especially as to the need for both types of tests to be included in the cement specifications.

Heat of Hydration.—A test program using a new simplified heat of solution method for determining the heat of hydration of portland cement has been completed and the results are currently being analyzed.

Methods of Chemical Analysis.—Study of improved and shortened procedures for the chemical analysis of cement resulted in procedures for manganese and phosphorus in 1937. Methods for determination of manganic oxide, sodium oxide, potassium oxide, and free lime were discussed in the October, 1938, BULLETIN and in the 1939 *Proceedings*. Further tests were included in the 1940 report of the committee. As a result of more recent studies, procedures were added to C 114 (chemical analysis of portland cement) for determining free calcium oxide, sulfide sulfur, water soluble alkali, and rapid alternate methods for sodium, potassium, calcium, magnesium, and titanium oxides, silicon dioxide, and sulfur trioxide. Current study is concerned with the cooperative testing by three laboratories of the flame photometer method for determining alkali content and in using more than one type of apparatus.

Air-Entrainment.—Extensive tests were conducted pertaining to the water requirements for the method of test for air content of hydraulic cement mortar (C 185). These cooperative tests included study of a Government test which employs a flow table and a constant water content method employed by one of the committee members. The committee is currently engaged in compiling and analyzing data resulting from round-robin tests on a number of cements.

Strength.—Early work in the committee resulted in a Method of Test for Compressive Strength of Hydraulic-Cement Mortars (C 109). Subsequent to the issuance of this method an investigation was initiated for the purpose of developing information as to the relative merits of using tensile, compressive, and flexural strengths of mortar specimens in predicting the flexural and compressive strengths of concrete. As a result of this work a tentative draft was circulated in Committee C-1 of a test for flexural strength for mortars; also a test for compressive strength of mortars using the portions of prisms broken in flexure. These proposed methods were published in the October, 1952, BULLETIN for information only.

Sulfate Resistance.—For years long-time and short-time test research has been conducted the results of which are intended to aid in the development of physical tests indicative of sulfate resistance and possible correlation of these tests with the chemical requirements of cement. The early results of this work were published in the 1945 *Proceedings*. Additional data appear in the 1946 *Proceedings* as well as a proposed method for testing sulfate resistance. Subsequent cooperative tests have included tests of 1:5 mortar bars (normal consistency) and 1:4 plastic mortar bars (wet and dry); a series of tests involved 17 laboratories evaluating sulfate resistance of cements both with and without air entraining agents. The results of this test series are now being reviewed and have been presented in a paper at the 1952 Annual Meeting.

Sulfur Trioxide Content.—In 1947 a special subcommittee initiated a research program to determine the optimum amount of sulfur trioxide for a given cement and to determine the degree of variation as it affects strength. A progress report was appended to the 1949 report of the committee. Data of this investigation indicated that the optimum SO_3 content as defined by strength and volume change of mortars is slightly less than the SO_3 content for maximum durability. The latest work of the committee based on these cooperative tests has been the issuance of a test for Calcium Sulfate in Hydrated Portland Cement mortar (C 265 T).

Time of Setting.—Based on a study of the results of two series of cooperative tests in which seven laboratories had tested four different types of cements, the committee issued in 1949 a Method of Test for Time of Setting of Hydraulic Cement in Mortar (C 229), and later a test for setting time using Gillmore needles (C 266). Further tests resulted in revision of Method C 229.

Volume Change and Soundness.—Data resulting from early studies were reported in the 1940 *Proceedings*, the same year in which the autoclave expansion test was issued (C 151). A summary was made in 1947 of the various methods of test for reactive aggregates and as a result of this study a method was issued (C 227) embodying the best features of each. Data have also been collected to support a revision of the method for potential alkali reactivity of cement-aggregate combinations (C 227 T) concerning the amount of mixing water.

Cement Reference Laboratory.—The Cement Reference Laboratory at the National Bureau of Standards is a joint

project of the Government and the ASTM and is supported by funds received from NBS, Public Roads Administration, and ASTM. The laboratory has continued its endeavors to promote uniformity and improvement in the testing of cement through inspection and advice to cement laboratories. More than 250 laboratories have requested that such inspections be made. The laboratory has prepared experimental mixtures for the calibration of flow tables and assists in the study of questions related to the apparatus and methods used for testing cements.

Committee C-3 on Chemical-Resistant Mortars

Bond Strength.—Several different procedures have been tried for determining the bond strength developed between acid brick and representative chemical-set silicate cements and resin cements. Duplicate cooperative tests are currently under way to confirm results obtained to date. Investigations have been completed recently on working and setting time of chemical resistant mortars.

Committee C-4 on Clay Pipe

Clay Flue Lining.—Because of the complexity involved in drafting standards for clay flue lining due to the variety in current practice and code requirements, an investigation of all service factors necessary for formulating such a standard is being conducted.

Committee C-7 on Lime

Soundness.—Early discussions of this problem and the solutions offered appeared in the 1934 and 1938 *Proceedings*. Data have been accumulated so that it is hoped a proper limit can be set on the expansion under the autoclave test.

Settling Test.—A large volume of experimental data has already been accumulated towards the development of a method for particle size determination by sedimentation.

Chemical Analysis.—Considerable committee work has been performed on round-robin testing for different methods of analyzing impurities in lime such as iron, CO_2, fluorine, and trace elements. In connection with these methods of chemical analysis the action of water—as free water, adsorbed water or water of hydration—as affected by temperature used in testing has been studied.

Slaking Test for Quicklime.—Current activities of the research subcommittee of C-7 are directed toward the developing of a new slaking test for quicklime, involving a new type of apparatus.

Committee C-8 on Refractories

Slagging.—While little actual research has been carried out on this subject, the refractories fellowship at Mellon Institute prepared a review of the literature which was published in the July, 1942, *Journal of the American Ceramic Society* bringing up to date the report issued in 1932.

Load.—An appeal to ceramic departments of various universities resulted in cooperation on the study on the effect of heating schedules and load on the flow of refractory materials and the development of an extensive program on possible methods for evaluating refractories used in pouring pits. Recommendations have been made that hydraulic machines with a uniform rate of loading, continue to be used. Single point loading is favored at present, but a study is being made of third point loading.

Spalling.—Based on early research work involving relation of vitrification to time, temperature, slag coatings, etc., various panel tests have been issued for determining resistance to thermal and structural spalling, including panel tests for refractory brick (C 38), high heat duty fireclay brick (C 107), super duty fireclay brick (C 122), and fireclay plastic refractories (C 180). Research at Mellon Institute resulted in subsequent revisions in these methods of tests. Current tests include the use of kaolin and alumina mixtures as a mortar in the panel spalling test.

Temperature.—Pyrometric test cones made from six standard samples, mechanically pressed and calcined, have been distributed to 28 cooperating laboratories. It is hoped that the data when assembled will show primarily the amount of variation that can be caused by different types of furnaces and secondly the range of difference between pyrometric cone equivalent tests in different laboratories using the same type of furnace. Currently a study of the effects of variation in length and thickness of cones is underway.

Chemical Analysis.—Methods of chemical analysis of refractory materials (C 18) were first issued in 1917. Extensive tests have been made since that time which have resulted in the inclusion of additional data in these methods. These cooperative studies have included a method for determining ferrous iron in chrome refractories materials; necessity of using absolute methyl alcohol saturated with dry hydrochloric acid *versus* the use of hydrochloric acid and ordinary methyl alcohol in the removal of boron in determining silica in high alumina refractories; the use of 0.2 N solution of potassium bichromate together with an appropriate indicator (this provides for an additional titration method in addition to the use of potassium permanganate); investigation of methods of determining loss on ignition of magnesite refractories containing lime.

Refractory Insulation.—A study in three laboratories of the effect of rate of load application on the measured strength of refractory insulators and insulating refractories indicates that the proposed increase in rate of loading by the hydraulic machine has no effect on the strength.

Porosity and Permanent Volume Change.—Research is currently under way designed to compare five methods now in use for measuring the bulk density of granular refractories.

Consistency and Plasticity.—In order to gain a fuller knowledge of plasticity and consistency of fireclay bricks a study was carried out on the correlation of yield value and mobility determinations. This research was completed in 1943 and two methods of test were issued, C 179 for shrinkage and C 181 for workability index. Subsequent to the issuance of these methods of test, additional studies were undertaken having to do with the finish of the mold, the rate of impact when molding, and a possible basic change in the principle employed in obtaining an index to workability.

Heat Transfer.—Research on methods for determining thermal conductivity has continued for many years. Three methods of test for thermal conductivity have been developed, fire brick (C 182) refractories (C 201) and fireclay refractories (C 202). Experimental work using C 202 brought out the fact that at least one brand of fire brick not only showed the property of changing in thermal conductivity with time and reaching a stable condition in which it could be satisfactorily measured, but also showed the unexpected property of changing back to its original condition on cooling. This was a porous high alumina refractory. Several other types of brick made from sintered and fused alumina were tested and showed normal behavior. Further tests with the standard apparatus found results in satisfactory agreement with deviations of not over 5 per cent.

Special Refractories.—Arrangements are currently under way for cooperation with the Special Refractories Assn. on a program of research on the testing of products not now subject to standard tests. Materials to be studied include silicon carbide, fused alumina, fused magnesia, and fused alumina-silica refractories.

Castable Refractories.—This class of refractory material has been in use for many years and although the industry and State and Federal governments have specifications for the material, Committee C-8 has not until recently had sufficient technical information to prepare satisfactory specifications. These specifications (C 213) are the result of an investigation of the properties of 12 brands of widely used commercial castable refractories and a survey of the requirements of castable refractories in the two types of furnaces involved.

Semi-Silica Brick.—Samples have been assembled for comparison by load test and P.C.E. test with the expectation that the results will throw light on the best method of classifying fireclay brick containing a high percentage of silica.

Committee C-9 on Concrete and Concrete Aggregates

Test Methods.—Test methods issued in previous years based on research work include the flow table method (C 124), making and curing compression specimens (C 31, C 192), securing samples of hardened concrete (C 42), sampling of fresh concrete (C 172), test for air content (C

173), and length of drilled concrete cores (C 174). More recent methods developed through research are methods for measuring fundamental transverse frequency of concrete specimens (C 215), bleeding (C 232), and evaluation of bond strength (C 234). Momentum was given to the consideration of air entrainment tests (C 231 and C 233) by the "Symposium on Entrained Air in Concrete" which appears in the 1947 *Proceedings*.

Admixtures for Concrete.—Subsequent to the securing of research data leading to a proposed method of test for evaluation of admixtures in concrete, additional tests were made and as a result a proposed method was issued as tentative in 1950 (C 233), with a tentative specification being approved in 1951 (C 260 T).

Chemical Reactions of Aggregate in Concrete.—Committee C-9 has cooperated with Committee C-1 on studying the problems resulting from the chemical reactivity of cement and aggregate in concrete. Further discussion of this problem can be found under Committee C-1.

Concrete Aggregates.—Based on the research work of this committee, various tests were issued including soundness test (C 88), abrasion (C 131), determination of clay lumps (C 142), soft particles (C 235), and others.

Durability.—This highly important property of concrete is receiving considerable attention in all its phases including the chemical and physical reactions of certain cement-aggregate combinations. A complete statement on this field of research was presented in "Some Unsolved Problems," January, 1951, BULLETIN.

Typical Problems.—An imposing list of typical problems that have been discussed is found in the C-9 news account which appeared in the December, 1952, BULLETIN including such problems as particle shape and its effect on concrete, wear test for concrete, effects of air entraining on concrete, and sampling.

COMMITTEE C-11 ON GYPSUM

Testing of Gypsum.—Based on several years' previous study of the ammonium acetate method for determining purity of gypsum, this method was included as an alternate in the standard methods C 26 in 1942. Problems currently to be the subject of research include a test for determining water permeability of gypsum sheathing board and study of subsieve fineness determination of gypsum particles. A procedure for water resistant characteristics of core-treated water-repellent sheathing has now been added to C 26 as a result of this previous research.

COMMITTEE C-12 ON MORTARS FOR UNIT MASONRY

Methods of Analysis of Masonry Mortars Taken From the Mortaring Board.—Attention is being given to development of methods for determining whether adequate quantities of portland cement have been added to mixtures of lime putty and sand delivered on the job and to determine whether masonry mortars taken from the board have adequate workability and probably will provide a suitable durability. A proposed draft of a method for analyzing fresh mortars appeared in the October, 1948, BULLETIN.

Efflorescence.—A cooperative program has been in progress to establish a satisfactory method of test for efflorescence of mortars. Proposed methods of test including the materials involved were agreed upon and to date results of tests conducted under this program indicate substantial progress toward the development of a standard test method. In an effort to present a clearer picture of the problem, F. O. Anderegg prepared a paper on this subject which appears in the October, 1952, ASTM BULLETIN.

Mortar Specifications.—Research and discussion extending over a period of 10 years resulted in the issuance in 1951 of specifications for mortars for unit masonry (C 270) which is now being reviewed for revision as a result of comments received.

COMMITTEE C-14 ON GLASS AND GLASS PRODUCTS

Chemical Durability.—A comparative study of ten methods on the chemical durability of glass and glass containers resulted after a series of cooperative tests, in the issuance in 1949 of Methods of Test for Resistance of Glass Containers to Chemical Attack (C 225).

Physical and Mechanical Properties.—One of the first round-robin testing programs of this committee resulted in the writing of a flexure test of glass (C 158). A review of existing methods for measuring thermal expansion, annealing, and strain point, and vapor softening point is nearing completion, and round-robin tests will be initiated to confirm the results. Through experience gained through five years of use, three standards issued in 1943 were revised. These included hydrostatic pressure tests (C 147) polariscopic examination (C 148) and thermal shock test (C 149). Based on experience of the Army Ordnance Dept., a Method of Sampling Glass Containers was issued in 1949 (C 224).

Block and Tile.—Accumulated test data on methods of sampling and testing produced the Methods of Sampling and Testing Structural Non-Load Bearing Cellular Glass Blocks (C 240).

COMMITTEE C-15 ON MANUFACTURED MASONRY UNITS

Weathering Characteristics.—Studies carried out by committee members were reported in the 1935, 1936, 1938, and 1939 *Proceedings* and covered such topics as water absorption, freezing and thawing test, and disintegration of face brick. Performance data on clay masonry products will be supplemented by a comprehensive research program of the Structural Clay Products Institute.

COMMITTEE C-16 ON THERMAL INSULATING MATERIALS

Physical Properties.—Cements, block, blanket, and other types of thermal insulating materials have been studied and research has resulted in Methods of Test for Bulk Density of Thermal Insulating Cement (C 164), Compressive Strength of Preformed Blocks (C 165), Covering Capacity and Volume Change of Cement (C 166), Thickness and Density of Blanket Type (C 167), Flexural Strength of Preformed Blocks (C 203), Testing Structural Insulation Board Made from Vegetable Fibers (C 209), and specifications for this latter material (C 208). A proposed draft of a specific heat test was published in the September, 1950, BULLETIN.

Conductivity.—Based on very extensive work over some years carried out through a joint committee of the American Society of Heating and Ventilating Engineers, American Society of Refrigeration Engineers, National Research Council, and ASTM, a test for conductivity of materials by means of the guarded hot plate was issued in 1942 (C 177). Detailed discussion of these studies was included in the 1942 *Proceedings* in a paper by F. C. Houghten. A test was later developed for thermal conductance of built-up sections by guarded hot box (C 236). Presently being developed is a test method for pipe material.

Vapor Barrier Study.—Fundamental research projects proposed relating to the study of vapor barriers include (1) velocity of diffusion, (2) permeability as a function of moisture content, (3) the effects of holes in vapor barriers, (4) isolation of the effects of diffusion, hygroscopicity, infiltration, and solution, (5) film resistance at the face of solids, (6) sublimation rating of water, (7) evaporation rate of water and (8) migration of water through walls. A method of test for water vapor permeability for thick materials is in the letter ballot stage.

Special Thermal Properties.—A second series of round-robin tests is currently being conducted based on a draft of a simple inexpensive method of measuring specific heat of insulating materials.

Handleability.—Several laboratories are cooperating in obtaining data using two types of impact machines for use in measuring the characteristic of handleability of insulating block.

Effect of Moisture.—A research project is being underwritten for the development of a method of testing the thermal conductance of insulation containing moisture and to determine the change resulting from moisture in its several forms.

COMMITTEE C-18 ON NATURAL BUILDING STONES

Marble.—Mellon Institute under the sponsorship of the National Association of Marble Producers is currently working on the subject of physical properties of exterior marble. Committee C-18 has offered to assist this project and is closely following this work. A comprehensive

research report on domestic marbles has pointed out that durability based on the gypsum test (C 218) does not give sufficient information and further basic scientific research in order to establish the relationship of structural characteristics of building stone will be continued at Mellon.

Texture or Grain Size.—The project of compiling nomenclature and definitions for natural building stones is at present directed toward the formation of standard size range definitions of "texture" or "grain size" based on average sizes of the quartz and feldspar crystals making up the stone. To determine these grain sizes each producer has been requested to submit a sample of his stone (with polished and broken rock face) giving his concept of the texture or grain size of the specimen.

Stone Masonry.—A joint research between the ASTM and the National Bureau of Standards involved the erection of a stone wall containing 2000 samples of 33 types of stone representing deposits in 45 states and several foreign countries. All samples are orientated so that each sample may be located and identified by its position. One half of the wall is set with portland cement mortar and the other half with lime mortar. The results of two years exposure were appended to the 1951 report of the committee.

Abrasive Resistance.—Accepted in 1950 the Method of Test for Abrasive Resistance of Stone Subject to Foot Traffic (C 241) was based on a long period of trial at the National Bureau of Standards and elsewhere and has already proved of value in avoiding such conditions of uneven wear as are evidenced in the floor of the Union Station in Washington, D. C., where the red tiles are shown (by this test) to be three times as hard as the white.

Committee C-19 on Structural Sandwich Constructions

Fatigue.—Preliminary arrangements have been made leading to round-robin tests on fatigue of sandwich constructions.

Exposure Testing.—Exposure tests of sandwich constructions are contemplated and the committee is at the present time studying a design for an outdoor exposure test cubicle as well as a proposal that a beam-type specimen be used for such testing.

Committee C-20 on Acoustical Materials

Maintenance.—Recommendations have been received that the committee undertake research projects on cleaning, painting, and dirt precipitation.

Committee C-21 on Ceramic Whiteware

Absorption.—As a result of a round-robin series of absorption tests recently completed, the committee should be in a position within the next year to issue a method for determining absorption.

Modulus of Rupture.—A research study is currently being undertaken to determine the reasons for conflicting results of modulus-of-rupture tests.

Modulus of Elasticity.—The potential usefulness of modulus-of-elasticity tests is the subject of current investigations.

Particle Size of Flint.—One of the newer problems within the committee is that of evaluating test methods for determining the subsieve sizes of flint.

Committee C-22 on Porcelain Enamel

Thermal Shock.—Resulting from a suggestion in 1950 one of the research projects currently active is that concerning the investigation of the development and appraisal of thermal shock tests.

Effect of Porcelain Enamels on Underlying Metals.—Currently being carried on is an investigation concerning the short- and long-term effect of porcelain enamels on the underlying metals when subjected to elevated temperatures.

Reflectance.—A proposed method for the determination of reflectance is ready for letter ballot of Committee C-22 but is being held in abeyance pending cooperative study among Committees C-22, D-1 on Paint, Varnish, Lacquer, and Related Products and E-12 on Appearance.

Particle Size.—A Test for Sieve Analysis of Wet Milled and Dry Milled Porcelain Enamel (C 285) was issued in 1951. Additional investigations are being carried on concerning rapid sieve testing methods of satisfactory reproducibility and the particle size analysis of subsieve fractions of milled porcelain enamels.

Finished Products.—Three tentatives for testing the resistance of porcelain enamel utensils to acid (C 282) boiling acid (C 283), and impact (C 284) have been developed by the committee. Tests for warpage, resistance to abrasion, and reflectance are under preparation.

Material Tests.—Studies of raw materials and materials in process concern warpage of enameling iron, effect of mill-added water composition on porcelain enamel, porcelain enamel consistency, and fusion flow methods.

Committee D-1 on Paint, Varnish, Lacquer, and Related Products

Drying Oils.—From the cooperative work by six laboratories in heat bodying tests, a method for same was issued in 1948 (D 967) and later incorporated in D 555.

Currently, cooperative tests are being carried out on hydroxyl number, break test, diene value, total iodine number, sampling methods, and a modified foots test.

Specifications for safflower oil are being drawn up and work on spectrophotometric analysis is being conducted in cooperation with the American Oil Chemists Society.

Traffic Paint.—Rapidly increasing use of traffic paints necessitated the preparation of adequate standard tests. Considerable data have been derived from laboratory tests as compared with road durability tests and these will be used in future work. A number of tests already have been developed for traffic paint: no pickup time (D 711), light sensitivity (D 712), road service tests (D 713), abrasion and erosion (D 821), bleeding (D 868 and D 969), settling (D 869), chipping (D 913), night visibility (D 1011), and test for roundness of glass spheres (D 1155).

Cooperative work is being conducted on methods of test for dirt retention time, accelerated durability tests and accelerated suspension tests, clarity, chemical stability, and settling of glass beads.

Volatile Solvents for Organic Protective Coatings.—Studies of solvency, compatibility of solvents in various mixtures, and methods of analysis of mixtures of various classes of hydrocarbons used as solvents and thinners, are being carried out in cooperation with Committee D-2 on Petroleum Products and Lubricants. The D-1 study, however, is directed particularly to the grades of material used in paints and their application to paint. Cooperative tests to establish a correlation between aniline point and Kauri butanol numbers resulted in the preparation of the Test for Aniline Point and Mixed Aniline Point of Hydrocarbons (D 1012), as well as tests for Kauri-butanol value (D 1133), heptane number (D 1132), nitrocellulose diluting power (D 1134), and copper corrosion (D 849). Further cooperative work with Committee D-2 includes study of distillation, flash point, and copper corrosion.

Reference Standards.—Since 1941 pictorial reference standards have been established for rusting (D 610), blistering (D 714), chalking (D 659), checking (D 660), cracking (D 661), erosion (D 662), abrasion and erosion of traffic paint (D 821), bleeding of traffic paint (D 868), and chipping of traffic paint (D 913).

Accelerated Tests.—The 1936, 1937, and 1940 *Proceedings* included reports of various tests including varnishes on steel panels, house paint exposure tests, and test results of enamels on steel and correlation with outdoor exposure. In 1937 a symposium was held on this latter subject and published as *STP No. 33*.

Cooperative tests designed to establish relationship between immersion tests made according to Method 870 and humidity tests, showed a satisfactory correlation in immersion tests but erratic results in the humidity tests, which are being studied further.

A cooperative program of the Cleveland Production Club for the study of laboratory exposure machines has been under way for several years. One of the objectives of this program will be the development of a method of rating blistering and accelerated weathering machines.

Consistency.—Based on investigations of certain instruments including the Stormer viscometer, ASTM consistency cup, Ford cup, etc. methods have been completed for testing nitrocellulose, clear lacquers, and lacquer enamels (D 333) and for consistency of exterior house paints (D 562). A new type of viscometer method was described in the 1947 Symposium on Paint and Paint Materials, *STP No. 75*. Two types of viscometers were described

in two papers, both published in the October, 1949, BULLETIN.

Chemical Analysis.—In addition to the numerous methods of chemical analysis for pigments, a method of test for common properties of certain pigments was approved by the Society at the 1952 Annual Meeting.

Work is proceeding on the revision of methods of analysis of titanium pigments and of white lead pigments in the Methods of Chemical Analysis of White Pigments (D 34).

Varnish.—In addition to the early work of the committee in the studies of the physical and chemical properties of varnishes more recent work has involved cooperative tests on methods of measuring dust-free time, set-to-touch time, tack-free time, and thorough drying. The results of much of this cooperative research were embodied in a 1950 revision to the methods of testing varnishes (D 154). Cooperative tests since 1950 have involved the study of a rapid means of determining nonvolatile matter, the use of pentaerythritol rosin ester for measuring the flexibility of varnishes, wearability of floor varnishes, and revision of the 1933 Gardiner color standards to obtain more acceptable color standards of greater permanency.

Optical Properties.—A number of projects have been the subject of considerable study and include methods of color specifications, goniophotometry, preparation of panels for gloss determination, color definition measurements, daylight reflectance, preparation of panels for apparent luminous reflectance of traffic paints, determination of gloss and tests for absolute hiding power. These studies have resulted in the revision of the gloss test (D 523) and the preparation of proposed drafts for 20-deg specular gloss and 85-deg sheen.

Cooperative work has been initiated with Committee C-22 on Porcelain Enamel and E-12 on Appearance to revise the luminous directional reflectance test (D 771) to meet the combined requirements of Committees D-1 and C-22.

Resins.—Extensive programs covering both methods of test and specifications for various types of resins have resulted in a number of standards including test for nitrogen (D 1013), total chlorine in vinyl resins (D 1156), and test for phthalic anhydride content (D 563).

Round-robin cooperative tests are in progress on the following: precipitation method for total solids, solvent tolerances of amine resins, nonvolatile determinations by precipitation, and a method for the determination of the apparent free phenol in phenolic resins.

Exposure Tests.—A number of wooden and metal panels were exposed in 1949 to study the dirt retention conditions and corrosiveness of certain test sites. These tests were completed in 1951. The results of these tests have not yet been made available to other than committee members.

Electrometric Testing.—A subcommittee on electrometric testing of paint films is currently conducting cooperative tests on a proposed method for conducting time potential tests on paint films.

Printing Ink.—Seven groups have been conducting round-robin tests on methods of tests for printing inks. As a result, a method for determination of "fineness of grind" is nearing completion. The other six groups are continuing their studies on test methods for rubproofness, rheology, drying time, and ink-paper relations. New groups have been organized to study density and tinting strength.

Flash Point.—Committee D-1 is actively cooperating with the Manufacturing Chemists Assn. as well as Committees D-2 on Petroleum Products and Lubricants and D-8 on Bituminous Waterproofing and Roofing Materials in the preparation of a Tag Open-Cup test method. A proposed method was published as information in an appendix to the 1952 report of the committee.

Physical Properties.—Early studies of the subcommittee on physical properties placed particular emphasis on the investigation of "gloss." Two methods were issued (D 307 and D 523). Later on studies were conducted on infrared reflectance and flame testing, numeric expression of color differences and adhesion of protected coatings. A method for producing uniform film thicknesses on test panels (D 823) was issued in 1945 and a test for film thickness (D 1005), several years later. Studies of abrasion resistance of coatings are reported in two papers published in the December, 1946 BULLETIN. A test method for abrasion resistance by the falling sand method (D 968) was issued in 1948. Present activities are centered on the following subjects: oil absorption of pigments, consistency of pastes, adhesion, specific gravity of pigments, hardness of paint films, chalk resistance of titanium pigments, permeability of paint films, fire retardancy of paints, wet film thickness and fineness of grind.

Painting of Structural Iron and Steel.—A detailed 1941 report described research work and summarized various investigations and inspections of panels on exposure. Reports covering earlier tests such as those at Havre de Grace and Atlantic City are listed. This subcommittee prepared the Method for Conducting Exterior Exposure Tests of Paints on Steel (D 1014) and currently is proceeding with the preparation with a set of colored photographic standards to be representative of various conditions of ferrous surfaces prior to painting.

COMMITTEE D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS

Gasoline.—Data reported in the 1939 *Proceedings* of a comprehensive series of tests extending over a five-year period, resulted in a Method of Test for Oxidation Stability of Gasoline (D 525). Studies of the sludge-forming tendency of fuels is being coordinated with a similar program carried on by the Coordinating Research Council.

Lubricating Oils.—Early studies of oxidation and bearing corrosion, foaming and laboratory testing of instrument oils resulted in numerous test methods. Under a project sponsored by the American Petroleum Institute a program has been initiated to determine the effect of various types of working devices on viscosity stability using the same four oils being tested for viscosity at various rates of shear.

A Symposium on High Additive Content Oils was held during the Pacific Area National Meeting in 1949 and was published as *STP No. 102*.

Studies on the oxidation, corrosion, spreading, and performance of instrument oils are continuing.

Turbine Oils.—Based on rather extensive interlaboratory tests of four turbine oils, a proposed test for oxidation characteristics (D 943) was issued in 1947.

Having established through cooperative tests the precision of a Test for Interfacial Tension of Oil Against Water by the Ring Method (D 971) the committee proposed this method for publication as tentative in 1948.

Four papers included in the Symposium on the Care of Inhibited Turbine Oils and Turbine Lubrication were published in the May, 1948, BULLETIN. A Symposium on Lubrication of High-Speed Turbine Gear Equipment (*STP No. 92*) was held in 1949. The Symposium on Turbine Oils held during the Pacific Area National Meeting was published in 1950 as *STP No. 105*.

Cooperative studies to determine the proper means of judging turbine oil quality will give indications as to the relative significance of increasing neutralization value.

A preliminary cooperative program has been initiated for determining the effects resulting from the mixing of two or more types of turbine oil.

Other projects include rotary bomb oxidation tests to determine oil life, correlation of neutralization values with peroxide content, development of emulsion tests, and preparation of a report on the compatibility of new and used turbine oils.

Diesel Fuels.—The committee is cooperating with the Coordinating Research Council, Inc., a research organization jointly sponsored by the American Petroleum Institute and the Society of Automotive Engineers in a number of diesel fuel projects including effect of fuel sulfur on engine operation, fuel deterioration effect on engine performance, ignition quality testing, railroad field service testing, front end volatility, corrosive tendency of fuels and fuel systems, deposit-forming characteristics, full-scale test techniques and combustion characteristics—ignition delay bomb.

Grease.—Early studies in the field involving consistency, melting point, and other properties resulted in a method of test for dropping point (D 566)—for discussion see 1937 *Proceedings*. More recent work has resulted in tests for apparent viscosity (D 1092), chlorine content (D 808), evaporation loss (D 972), and oxidation stability (D 942). Other technical studies include: (*1*) Effect of grease on

metals in storage, (*2*) Study of the Method of Test for Cone Penetration of Lubricating Greases (D 217) in conjunction with multiple mechanical working of grease samples, (*3*) A cooperative test program on the determination of dirt in greases, (*4*) An extensive cooperative test program for evaluation of the wheel-bearing grease tester described in the Proposed Method of Test for Performance Characteristics of Wheel Bearing Grease published as Appendix I to the 1948 Report of Committee D-2, (*5*) Test methods for the determination of lead, sulfur, chlorine, and phosphorus in greases. Research Division III on Elemental Analysis, (*6*) Methods for determining the consistency of semifluid greases, (*7*) Prediction of storage stability of greases, (*8*) Investigation of the micro penetrometer and micro worker, (*9*) Functional tests for high-temperature antifriction bearing greases, and water-resistant greases. (*10*) Work softening and age hardening of greases. (*11*) Development of a standard ball bearing grease testing machine. (*12*) Development of suitable standardized test equipment for determining the starting torque and running torque characteristics of ball bearing greases at low temperatures.

Technical Committee G on Lubricating Greases sponsored a Symposium on Fretting Corrosion at the 1952 Annual Meeting.

Light Hydrocarbons.—The results of a cooperative test program conducted by the Office of Rubber Research on Reproducibility and Repeatability of the Koppers-Hinckley Method of Test for Determination of Butadine Content of Polymerization Grade Butadiene are appended to the 1947 report of the committee.

The committee is cooperating also with the California Natural Gasoline Assn. and the National Gasoline Assn. of America in the study of vapor pressure, sulfur content, and methods of sampling liquefied petroleum gas.

Cutting Fluids.—A symposium on cutting fluids was held in January, 1947, and the papers published in the March, 1948, BULLETIN. Eleven cooperating companies have agreed to set up lathes for running accelerated service tests on cutting fluids.

Combustion Characteristics.—The research division on combustion characteristics is currently sponsoring three major projects, (*1*) a study of the reproducibility of the C.R.C. F-21 procedure for rating aviation fuels, (*2*) a study of the effect of barometric changes on the rating of fuels, (*3*) a continuation of the National Exchange Group cooperative program for maintaining accurate operation of knock test engines.

Measurement and Sampling.—Two long-range and very extensive projects are nearing completion. The first of these has been under way since 1946 with the cosponsorship with the British Institute of Petroleum and deals with the development of petroleum measurement tables based on the three most widely used systems of measurement—U. S. units, British (Imperial) units, and metric units. The second large-scale project is the preparation of calibrating liquid containers larger than a drum.

Elemental Analysis.—Two symposiums have been held under the auspices of Research Division III on Elemental Analysis. The first held during the 1949 Pacific Area National meeting covered Modern Chemical and Instrumental Methods for the Determination of Metals in Petroleum Products. The second symposium held February, 1950, in Washington, D. C., included seven papers on the subject of Recent Developments in Instrumental Methods for the Determination of Tetraethyl Lead in Gasoline.

Hydrocarbon Analysis.—Current cooperative work is being conducted in an effort to develop procedures for the determination of existent gum or nonvolatile residue in gasoline containing dissolved nonvolatile lubricating oil, in jet fuels, and in other fuels boiling above the gasoline range. A test program is under way to evaluate a silver mercuric nitrate method for olefins in gas samples.

Analysis of Fuels.—Sixteen laboratories are collaborating in a program to evaluate a proposed steam jet method for determining gum content in aircraft turbine and jet fuels.

Analysis of Lubricants.—Work is continuing on cooperative tests on D 94, Test for Saponification Number of Petroleum Products by Color-Indicator Titration in order to check the merits of paraxylenol blue as an indicator and the effect of saponification time. Tests have been run on new lubricating oils to compare mixtures of cyclohexane and heptane with ASTM precipitation naphtha to determine whether more uniform precision can be obtained from the naphtha used.

Flow Properties.—A study of Method D 97 Test for Cloud and Pour Points as to its reproducibility for measuring the cloud point of low pour point products resulted in widely varying results. Round-robin work is continuing.

Results of cooperative tests conducted in the development of a method of test for pour stability characteristics of winter grade motor oils are appended to the 1950 report.

Volatility.—Several years active cooperative work have resulted in a proposed method of test for reduced pressure distillation of petroleum products (1950 *Proceedings*).

Work is under way toward the development of a vapor temperature—pressure correlation which can automatically be used for the conversion of distillation curves obtained at 10 mm or less to atmospheric pressure. This work is being conducted at Northwest Institute of Technology.

A test program is being initiated to determine the possibility of including a null point head and manometer as a substitute for Bourdon gages in the Reid vapor pressure measurement.

Color.—Consideration is currently being given to a new color scale defined in fundamental spectrometric units which slightly extends the present ASTM union colorimeter scale (D 155).

The development of a color scale for pharmaceutical petrolatums is being considered either for inclusion within the new scale or as a separate scale.

Development of glass color standards for aviation gasolines has been started.

Graphite.—Research Division XII on Graphite Tests organized in 1951 has, as a result of cooperative programs, made considerable progress on analysis, abrasion testing, and particle size of graphite.

Paraffin.—Based on tests in seven laboratories a Method of Test for Oil Content of Paraffin Wax was issued in 1943 (D 721). A current program to determine merits of a new method for determining oil content of both paraffin and microcrystalline wax has been started.

Viscosity.—Resulting from investigations involving particularly kinematic viscosity were methods of test using the suspended level and modified Ostwald instruments and a method for conversion of kinematic viscosity to Saybolt Universal and Furol viscosity (D 445, D 446, and D 666). Determination of viscosity at high rates of shear is under study paralleling the studies in the American Petroleum Institute and the American Society of Mechanical Engineers.

Sulfur.—Studies to improve the accuracy of the lamp sulfur method resulted in the publication as information in 1947 of a new CO_2-O_2 method for determination of sulfur content for petroleum products by lamp method. Minor difficulties encountered have not as yet been reconciled.

Neutralization Number and Saponification.—The 1941 D-2 Report gave results of a comprehensive test keeping numerous variables closely controlled including temperature, time, degree of agitation, type and strength of solvents, and strength of alkali. This investigation resulted in two tests for neutralization number, one by color indicator titration (D 663) and one by electrometric titration (D 664). The 1942 report gave a summary of cooperative tests on saponification number of weights and satisfactory oils resulting in revisions in the test for saponification number by color indicator titration (D 94). Further cooperative tests lead to the issuance of the Test for Acid and Base Numbers by Color Indicator Titration for Neutralization Value (D 974) in 1948. Method D 663 was discontinued at that time and the test incorporated in D 974.

Cloud and Pour Tests.—Experience has shown that lubricating oils containing either natural or synthetic pour point depressants solidify under certain atmospheric temperature cycles at temperatures not predicted by ASTM Method D 97. A study of this effect led to the publication as information of a proposed method of test 1945 (*Proceedings* p. 244). Field tests were conducted during 1944, 1945, and 1946 and although the proposed method correlated better with practical storage than Method D 97 (January, 1946, BULLETIN) much was left to be desired and a study of field winter tests is continuing.

Plant Spray Oils.—Distillation test method D 447 and test for unsulfonated residue D 483 were revised in a cooperative effort with the Pacific Insecticide Institute. Studies by the committee resulted in a method of test for aniline point (D 611). Recent tests have resulted in revisions in this method.

Petroleum Sulfonates.—Method of Analysis of Petroleum Sulfonates (D 855) issued in 1945 was the result of considerable cooperative research work. This work, still under way, includes research projects for determining sulfonate content, oil content of sulfonate samples, water, moisture and volatile matter, inorganic salts, and analysis of calcium and barium petroleum sulfonates. A proposed draft of analysis of calcium and barium petroleum sulfonates was published in the 1948 *Proceedings*.

Analysis of Petroleum Products for Hydrocarbon Types.—An extensive program of development of analysis of petroleum products has resulted in the issuance of tests for determination of aromatic hydrocarbons (D 936), pycnometer density (D 941), determination of purity (D 1016), and freezing point measurement (D 1015). A cooperative test program on five diesel fuels has recently been completed and cooperative tests are planned on a fluorescent indicator procedure for the rapid determination of aromatics.

Extreme Pressure Properties.—Observations based on the results of a cooperative test program involving the testing of 12 lubricating oils of varying extreme pressure levels in the Timken Test Machine were published in the April, 1952, BULLETIN. This work is continuing and further results and conclusions will be published in a future issue of the BULLETIN.

COMMITTEE D-3 ON GASEOUS FUELS

Measurement of Gaseous Samples.—Through active participation of their representatives the committee has been able to instigate and use research work carried out at the National Bureau of Standards, Pennsylvania State College, and other laboratories, and has issued a method for measurement of gaseous fuel samples (D 1071), based on this investigative work.

Specific Gravity and Density.—The Bureau of Standards made more than 2000 specific gravity determinations on 15 test gases using eleven instruments submitted by various manufacturers. A 240-page report was prepared and distributed to the members of Committee D-3. As a result of this extensive investigation Methods of Test for Specific Gravity of Gaseous Fuels (D 1070) were published in 1949.

Special Constituents of Gaseous Fuels.—An investigation is now in progress at the Institute of Gas Technology, Chicago, Ill., on the identity and proportions of specific sulfur compounds in gaseous fuels. One investigator is devoting his full time to the preparation of analytical methods covering determination of total organic sulfur, carbon disulfide, carbon oxysulfide, mercaptans, and thiopenes.

Water Vapor Content.—Intensive work was carried out at The Pennsylvania State College on a laboratory method which depends on the absorption of light by the water vapor at a particular wavelength in the near infrared and a field method which depends on the change of color of cobaltous bromide in an organic solvent on the addition of water. This investigation was described by F. C. Todd and A. W. Gauger in the 1941 *Proceedings*. Further studies were conducted on the use of a water vapor detector, the principle of operation of which is based on change in conductivity of a phosphoric acid film as affected by the absorption of moisture. One of the results of these studies was the issuance of a Test for Water Vapor Content of Gaseous Fuels by Measurement of Dew Point Temperature (D 1142).

Complete Analysis of Gaseous Fuels.—Results of studies on two standard samples of gas analyzed in some 20-odd laboratories are published in the NBS *Journal of Research* for March, 1946. These early tests were supplemented by additional cooperative programs and reports of this work were issued by the committee. As a result of tests on four methods of analysis of fuel gases, two methods have been accepted. One for analysis by the mass spectrometer (D 1137) and one for analysis by the volumetric chemical method (D 1136).

Calorific Value.—The Test for Calorific Value of Gaseous Fuels by the Water-Flow Calorimeter (D 900) issued in 1946 is an extensive method giving in detail requirements for apparatus test procedure, theory, and calculations for this test, which is of fundamental importance in evaluating gaseous fuels.

COMMITTEE D-4 ON ROAD AND PAVING MATERIALS

Asphalt Content.—In developing the new Tentative Method of Test for Vacuum Distillation of Liquid and Semi-Solid Asphaltic Materials to Obtain a Residue of Specified Penetration (D 1189-52 T) an elaborate series of cooperative tests was conducted involving 14 samples of SC-3 road oil. Selected data from these tests immediately pertinent to the determination of 100-penetration residue are appended to the 1952 report.

Physical Tests for Compressed Bituminous Mixtures.—Cooperation with the Triaxial Institute is continuing in fundamental studies at present concentrating on methods for formation of specimens and influence of compaction methods on the physical properties of compacted specimens.

Distillation Tests.—Several cooperative tests to study modifications of D 402 have been concluded with the objective of providing for tests on all types of cutback, minimizing foaming difficulties, and at the same time obtaining test results with the revised methods as would be obtained by the present standard method. A new series of cooperative tests is planned for the purpose of obtaining data for preparation of a statement on reproducibility in connection with the test for distillation of tar products suitable for road treatment (D 20).

Softening Point.—Cooperative tests are planned to study several features of the ring-and-ball softening point tests in an effort to develop a satisfactory method combining the two methods now published by the Society.

Extraction and Recovery of Constituents from Bituminous Mixtures.—The result of an investigation beginning in 1940, a method based upon a simple hot extraction paving sample, a standard procedure for centrifuging to remove the fine material matter, and a standardized distillation procedure using CO_2 based on the widely used Abson Procedure (see 1950 *Proceedings*), resulted in the publication in 1944 of D 762. A summary of data on which this method is based was included in the 1944 report of the committee. Further cooperative work has been undertaken to modify this procedure.

Viscosity and Float Test.—Cooperative tests to obtain data on the reproducibility of the Engler specific viscosity test for which a proposed tentative method has been prepared will be conducted in the near future.

The Setting Qualities of Bituminous Materials.—Committee D-4 is continuing its cooperative test program to develop a method to measure the curing properties of bituminous materials with particular attention to rapid curing and medium-curing cutback materials.

Emulsion Tests.—Cooperative work by four laboratories resulted in a proposed method of test for residue by evaporation which has been incorporated in Method D 244.

A test program has recently been completed to establish an acceptable procedure for determining the viscosity of emulsified asphalts at 122 F.

Accelerated Tests for Durability of Bituminous Materials.—A review of a number of thin film oven and weathering tests has been made prior to the organization of a cooperative testing program to study the thin film oven test.

Solubility Tests.—Results of a series of cooperative tests on the determination of bitumen in connection with the revision of Method D 4 were published in the 1950 report of the committee.

Effect of Water on Compressed Bituminous Mixtures.—Several series of tests resulted in the Method of Test for Effect of Water on Cohesion of Compacted Bituminous Mixtures (D 1075) in 1949. Further cooperative tests are planned with a view to expanding the use of this method.

Effect of Water on Bituminous Coated Aggregates.—Although a standardized test method has not as yet reached the publication stage, cooperative tests conducted in the past several years designed to develop a procedure for measuring the adhesion of bituminous films to mineral

aggregates and resistance of these films to stripping, have developed much valuable information and a summary of the work to date is appended to the 1952 report of the committee.

Soil Bituminous Mixtures.—A report of research was presented to the joint subcommittee of Committees D-4 and D-18 at the Annual Meeting in 1946 (see 1946 *Proceedings*) resulting in methods of test (D 915) in 1947. Studies are continuing on (*a*) compaction, density, and moisture in soils (*b*) permeability of granular stabilized soils mixtures (*c*) a method of test to determine the strength of granular stabilized mixtures and (*d*) a study of the moisture-proofing ability of various admixtures. Method D 872, sulfonation index of road tars, was based on extended cooperative work under the auspices of the American Assn. of State Highway Officials.

Committee D-5 on Coal and Coke

Analysis of Coal and Coke.—A Special Section on Revision of Ultimate Analysis Methods has been active in accumulating data and conducting experimental work based on research studies by such groups as Battelle, Canadian Bureau of Mines, Eastern Gas and Fuel Associates, Illinois State Geological Survey, Institute of Gas Technology, School of Mineral Industries, and U. S. Bureau of Mines.

Coal Ash Fusion Test.—To obtain information on how best to specify the nature of the reducing atmosphere in the standard coal ash fusion test a cooperative investigation was undertaken using gas-fired and electrically-heated furnaces. Seventeen laboratories cooperated in these investigations and the results were described in the U. S. Bureau of Mines report RI 3724 and in a paper by W. T. Reid and P. Cohen published by ASME in May 1944 in a collection of reprints of various papers entitled "Furnace Performance Factors."

Uniformity of Analytical Data.—To determine the precision of procedures covered in widely used Standard Methods of Laboratory Sampling and Analysis of Coal and Coke (D 271) Messrs. Lowry and Junge prepared a paper for publication in the 1942 *Proceedings* in which were presented analytical data on 100 samples of coal or coke.

Sulfur Determination.—The 1942 report of Committee D-5 discusses a comprehensive study of volumetric methods for determining sulfur. Results indicated that the volumetric methods yield results of the same degree of accuracy as the present gravimetric method incorporated in D 271. Details of research investigations were covered in a paper by S. S. Tompkins which appeared in *Industrial and Engineering Chemistry*, Vol. 14, 1942.

Sampling and Fineness of Powdered Coal.—An extensive sampling experiment is under way at a large utility power plant in cooperation with a group representing the Edison Electric Institute. It is hoped eventually to formulate specifications for continuous sampling of coal in large handling systems such as are found in most utility generating plants.

Methods for determining surface area of coal particles by means of measurement of resistance of air flow are being investigated.

Plasticity and Swelling of Coal.—A study is being made of methods of testing expanding properties of coals during coke manufacture. Investigation of plastic properties of coals as affecting their combustion characteristics is also being conducted. Work done by the Bureau of Mines and published in the 1943 *Proceedings* was later described in Bureau of Mines *Technical Papers 650, 655, 667, 670, 672,* and *683* and in *Report of Investigations 3760*. A comprehensive critical review of published information on test methods for measuring the plastic and swelling properties of bituminous coking coals was given in Bureau of Mines *Bulletin 445*. The committee reported results in 1949 of cooperative tests by different laboratories using the Gieseler plastometer method on standard samples of two widely different grades of pitch. Detailed results of further tests involving the Gieseler method were reported in 1951. This study is continuing with further work aimed toward elimination of unwanted variables.

Ignitibility.—A paper describing the work at Battelle on suitable tests for determining ignition temperatures of fuels was published in the October, 1941, Bulletin. Two papers covering research on laboratory methods of testing the reactivity of solid fuels to oxidizing gasses were presented in 1948. The paper by A. A. Arning, S. Mallov, and M. Neff appeared in Vol. 40 of *Industrial and Engineering Chemistry*. The second paper by Jonakin, Cohel, Corey, and Jain appeared in the 1948 *Proceedings*. The committee is continuing its study of a desirable laboratory method for testing ignitibility of coal.

Committee D-6 on Paper and Paper Products

Test Methods.—In addition to the many test methods which have already been developed by Committee D-6, current activities are directed toward test methods to determine light fastness, moisture expansivity, and erasibility. Similar tests such as immersion number, stack bending, etc. are being developed for fiberboard and container board.

Committee D-7 on Wood

Effect of Specimen Shape on Tensile Strength of Plywood.—The purpose of this research was to compare results obtained with several types of test specimens including specimens of reduced cross-section with various fillets and the comparison of results with specimens employed for tests of plastics. Two alternate tension specimens have been recommended for use when maximum tensile strength only is required.

Effect of Specimen Shape on the Compressive Strength Properties of Plywood.—This research was devoted to comparing results obtained with prism shaped specimens such as those commonly used for compression tests on wood and plywood with hour-glass shaped specimens of two different types. The results were presented in an article by J. A. Liska in the March, 1945, Bulletin. Results of the study have been used as a basis for revisions in D 805.

Timber Specifications.—Possible revision and classification of Methods for Establishing Structural Grades of Lumber (D 245) is under study in view of current investigations of basic principles of structural grading and factors affecting the strength of wood in compression.

Laminated Timber.—Completion of extensive studies by the U. S. Forest Products Laboratory in cooperation with Committee D-7 resulted in the Method of Test for Integrity of Glue Joints in Laminated Wood Products for Exterior Service (D 1101). Further research is being conducted at the Forest Products Laboratory on accelerated tests for adhesives.

Wood Poles and Cross Arms.—A testing program has been formulated to provide test data comparing two specific methods (transverse bending of three-point loading in a testing machine and cantilever bending under a load applied at the top of a pole held horizontally in the butt of a crib) and the correlation of these results with fiber stress determinations obtained by laboratory testing of small clear specimens cut from the same poles.

Test Methods for Wood.—Research has continued on the improvement of a tension-parallel-to-grain test specimen as a modification of the methods of testing wood (D 143).

Moisture in Timber.—Studies of determining moisture in heavy timber by electrical measurement were reported in the 1933 *Proceedings;* data on the steam pipe oven for determining moisture were reported in the 1936 *Proceedings*. Since that time a research has been conducted in the field of application of instruments for determining the moisture content of wood and in the development of new or improved methods applicable to the determination of moisture content. Improvement has been made during the years in the main problems involving the use of the apparatus, namely that of accurately determining the dewpoint. By 1947 the maximum deviation had been reduced to 1.3 per cent.

Fire Retardant Wood.—Coordination with the American Railway Engineers Assn. to secure data on experience and classification of exposures with respect to requirements for fire-retardant treatments is continuing. Because of the many problems concerning the interpretation of data relating to fire tests it will be some time before any specifications or recommendations are forthcoming.

Chemical Analysis.—This year Subcommittee XIV on Methods of Chemical Analysis completed the eleventh in a series of methods of chemical analysis by finishing an evaluation of the method of analysis of methoxyl in wood.

Committee D-8 on Bituminous Waterproofing and Roofing Materials

Stain Properties.—The Committee is trying to develop a method or methods for

measuring accurately the extent to which bituminous materials exude an oily constituent under conditions of use which result in staining of such things as laminated paper, paper roofing, and floor coverings.

Compatibility Tests.—A subcommittee has recently been created charged with developing tests for determining the compatibility of bituminous materials for roofing and waterproofing.

Committee D-9 on Electrical Insulating Materials

Insulating Varnishes.—One of the most early and perplexing problems in this work concerned the problem of internal drying time. Cooperative tests were conducted to determine whether the Navy tests for deep-drying characteristics of varnishes would satisfactorily evaluate a varnish for drying or hardening in the interior of a deep layer coil.

Extensive tests on the determination of salt water resistance of varnish films failed to develop a satisfactory method and the investigation was discontinued.

Round-robin tests were made in an effort to evaluate a method for film continuity, draining characteristics, moisture resistance, and also on a method for determining mechanical properties by measuring creepage.

A round-robin testing program for set time of heat reactive laminating varnishes was completed in 1950.

Molded Insulating Materials.—Early research work resulted in methods of testing molding powders (D 392) method of measuring shrinkage from mold dimensions (D 551). Because of the importance of mold design on tension specimens interlaboratory work was undertaken to procure data from which a standard mold design could be prepared which was partly responsible for the specification for molds for test specimens (D 647).

An important activity has been to establish specified values for electrical tests of phenolic materials. Much of this work is of interest to Committee D-20 on Plastics.

Plates, Tubes, Rods, and Molded Materials.—Round-robin tests carried out on different materials using Method D 696 (creepage of linear thermal expansion of plastics) resulted in the addition of tests for thermal expansion to the methods of testing sheet and plate insulation (D 229).

Based on a long program of cooperative tests a test for punching quality of laminated phenolic sheets was developed (D 607). Hardness tests at room temperature or elevated temperatures have been found to give an indication of quality as reported in the appendix to the 1941 report of the committee.

A round-robin test on flexural strength of thin test specimens of sheet materials has been completed and a statistical analysis of the data is being studied.

Liquid Insulation.—The 1943 report of Committee D-9 gives a condensed summary of activities involving neutralization number, sludge test, insulating oils, askarels, and resistivity and power factor tests. Correlation tests were continued in 20 cooperating laboratories to determine relation of sludge test values by method D 670 to actual service life of insulating oil in transformers. Round-robin studies of the Carl Fisher and Doble methods of determining minute traces of water or moisture in insulating oils were conducted in 1947. The Doble method is described in a paper in the 1946 *Proceedings*, "Water Determination in New and Used Insulating Oils by Doble Method."

During the same year round-robin tests on interfacial tension were conducted using samples of both new and used insulating oils. The second of a series of symposiums on insulating oils was held in June, 1947, the papers of which were published in the December, 1947, Bulletin.

As a result of the interfacial tension tests a method of test was issued in 1948 (D 971). Reprints of the papers and discussions of the March, 1949, symposium were made available as *STP No. 95*.

Ceramic Products for Electrical Purposes.—Cooperative tests have involved flexural strength, tensile strength of electrical porcelain, and methods for determining mechanical strength of steatite. The 1941 *Proceedings* included a "Report of Round-Robin Tests on Power Factors and Dielectric Constant for Glass" (describing the work of five laboratories on five different types of glass to help in correlating measuring techniques). An extensive round-robin testing program resulted in revisions of D 667, Methods of Testing Steatite Used as Electrical Insulations. These proposed revisions included conditioning procedures for resistivity power factor and dielectric constant.

Solid Filling and Treating Compounds.—Round-robin tests on microcrystalline waxes have been prepared and upon completion of the test methods specifications for microcrystalline waxes will be prepared. These tests will result in a revision of Methods of Testing Solid Filling and Treating Compounds Used for Electrical Insulation (D 176) including the methods applicable to microcrystalline waxes.

Insulating Fabrics.—Revisions in 1951 of D 373 specifications for black bias-cut tape resulted from an extended research on the dielectrical strength characteristics of various types of varnished cloth tapes.

A round-robin study was made in 1948 of the effect of exposure to relative humidities of 90 and 96 per cent on the dielectric strength of varnished cloth tapes.

A round-robin study has been made of the effect of hot oil on treated sleeving as well as an investigation of the effect of heating on the flexibility of treated glass tapes.

Additional round-robin tests have been conducted on both oleoresinous and silicon varnished glass fabric samples.

Electrical Insulating Papers.—A new method for pH value of paper was included in Methods D 202 as a result of round-robin tests conducted by a joint D-6—D-9 Committee. Methods D 202 have had other revisions or modifications including changes in the rate of impregnation test and electrometric method for pH determination measurement of sulfate residues, water and alcohol soluble material, and revisions in the deterioration test.

Mica.—Extensive groundwork instituted and carried to completion by Bell Telephone Laboratories under War Production Board contracts resulted in an electrical system for classifying mica (D 748). The work by the Bell Telephone Laboratories indicated that certain classes of mica heretofore thought unsuited for certain particular electrical applications can be used quite satisfactorily. Following the issuance of this standard (D 748) a round-robin study was conducted—

1. To determine the degree of agreement among various laboratories.
2. To determine whether circular lead foil electrodes 2 in. in diameter were satisfactory, and
3. To determine the dielectric constant of block mica approximately 0.020 in. in thickness at one megacycle.

Results of this round-robin test were presented in a paper by K. G. Coutlee in the 1946 *Proceedings*.

A round-robin test program is currently under way for the purpose of verifying the calibration of the new parallel-to-laminations technique in Method B, Appendix 1 of the Specifications for Natural Block Mica and Mica Films Suitable for Use in Fixed Mica-Dielectric Capacitors (D 748).

Electrical Tests.—Early research work resulted in the development of a standard resistivity test (D 257) and revision of the test for power factor (D 150). A description of extensive work on solid dielectrics appeared in the 1941 report of the committee. Round-robin tests were made by eight laboratories on Method of Test for High-Voltage, Low-Current Arc Resistance of Solid Electrical Insulating Materials (D 495). Although statistical analysis of the data indicated an over-all average variation of 25 per cent the general opinion was that this method was a definite improvement over the previous method. A more limited round-robin is planned to investigate the reasons for disagreement on the results obtained for some special "arc-resistant" materials.

Next Month—

The February issue of the ASTM Bulletin will carry the concluding portion of this research review. This will include the rest of the "D" committees, covering miscellaneous materials and the "E" committees covering miscellaneous subjects such as methods of testing, spectroscopy, metallography, etc.

TECHNICAL COMMITTEE NOTES

Copper Committee Discusses Proposed Specification Actions for 1953

DURING its November 18 and 19 meetings at ASTM Headquarters, Committee B-5 on Copper and Copper Alloys, Cast and Wrought gave consideration to many actions on copper and copper-alloy specifications, a large proportion of which will probably be recommended to the Society for final action at its 1953 Annual Meeting.

Three new specifications are now being balloted upon in subcommittee. These are for copper and copper-alloy die forgings, for refrigeration service seamless copper tube, and for nickel-tin bronze sand castings. Likewise the following changes in existing specifications have reached the same stage:

1. Specification B 14 for Seamless Brass Boiler Tubes at present requires a minimum copper content of 68.5 per cent. It is proposed to add a maximum limit of 71.5 per cent.
2. In specifications B 21, B 43, B 111, B 138, and B 150 covering copper alloys in various forms, the committee is providing for more than one specimen for the mercurous nitrate test.
3. At present Specifications B 130 and B 131 refer to the nominal 90 per cent copper-zinc alloy as "gilding metal." The standard industry nomenclature uses "commercial bronze" in referring to this alloy and "gilding metal" when referring to the nominal 95 per cent copper-zinc alloy. The committee is therefore proposing that Specifications B 130 and B 131 refer to "commercial bronze."
4. Specification B 152 for Copper Sheet, Strip, Plate, and Rolled Bar contain for general information Rockwell hardness values on the "B," "F," and Superficial 30-T scales. The values for the "B" scale are to be deleted.
5. In Specification B 171 for Copper-Alloy Condenser Tube Plates the bend test is to be deleted and the maximum tin content requirement of 1.5 per cent is also to be deleted.
6. General Requirement Specification B 248 for Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar is to have some dimensional tolerance changes in its tables, reflecting present commercial practice.
7. Specification B 272 for Rectangular Copper Wire for General Purposes is to have added requirements for finished-edge rolled strip up to 12 in. wide.

The following 12 items had been assigned previously to small task groups in the subcommittees, and continued consideration is being given to them. While no final decision has yet been made, the possibility is good that several will reach final stages in 1953.

1. For design purposes the Boiler Code Committee of The American Society of Mechanical Engineers has asked that yield strength values be established for the copper and copper-alloy materials used by the Boiler Code.
2. Requirements for 10 and 12 per cent nickel silver sheet, rod, and wire.
3. A review of Specification B 75 for Seamless Copper Tube with special consideration to the Rockwell hardness and tempers.
4. A revision of the dimensional tolerances in Specification B 111 for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock.
5. The addition of dimensional requirements for rectangular and square copper bus tube furnished to Specifications B 188.
6. In Specification B 135 for Seamless Brass Tube a review of the straightness tolerance.
7. In General Requirement Specifications B 248, B 249, B 250, and B 251, a study of the sampling and retest requirements with reference to statistical quality control.
8. In Specifications B 96, B 97, B 98, and B 99 for Copper-Silicon Alloys, the deletion of inactive alloys and simplification of remaining chemical requirements.
9. Proposed specification for manganese brass sheet for resistance welding.
10. Proposed methods for measurement of dimensional tolerances.
11. Proposed methods for measuring grain size.
12. Proposed classification of wrought copper-base alloys.

As a result of the discussions at the November 18 and 19 meetings many new tasks were assigned to small groups of subcommittee members for preliminary discussions and recommendations to the subcommittees. These will be reported when Committee B-5 holds its next meeting in the Spring of 1953.

Acoustical Materials Committee Writing Specifications and Method Standards

COMMITTEE C-20 on Acoustical Materials has reached its first milestone of progress since its organization a brief three years ago. Very encouraging reports were presented at the meeting held at ASTM Headquarters in Philadelphia on December 4 and 5, indicating that several projects have reached the stage where proposed test methods are being written for adoption as new ASTM tentative standards.

In the basic field of the measurement of sound absorption, the first draft of the impedance tube method has been written, and it is planned to circulate this proposed method to subcommittee letter ballot during the next two months. Good progress was reported on the completion of round-robin tests with samples now being run in the last of seven reverberation chambers included in the series. Three additional laboratories have expressed a desire to run tests on standard samples in their impedance tube apparatus. A report is expected on the box method at the next meeting. It is felt that this type of test method, being a control method, will be presented as information only, rather than as a possible ASTM tentative. It is especially useful for perforated fiberboards of a homogeneous nature. A third method, the close-up method, was discussed in terms of a proposed research project.

The Subcommittee on Fire Resistance reviewed the activities now going on in other ASTM committees, as well as outside the Society, on a proposed test method for measuring fire resistance or flame spread. Test data will be available to the subcommittee from a series of tests now being conducted at the Riverbank Laboratory, sponsored by the Acoustical Materials Assn. This involves a modified form of the test procedure as found in Federal Specification SS-A-118a. It is the consensus that a test procedure acceptable to the committee can be similar to that being developed by Committee C-16 on Thermal Insulating Materials, and to the test procedure being used at the Riverbank Laboratory. A proposed draft of a test method will be prepared by a special task group designated to work out the differences in detail which

now exist between the methods now recognized by Committee C-16, the Acoustical Materials Assn., and the Federal Specification group.

The two principal current projects of the Subcommittee on Maintenance involve paintability and staining. The first draft of a proposed method on paintability was discussed at some length. This draft included both laboratory and field methods. It was agreed finally to concentrate on the laboratory test only, holding the field test procedure for later attention. This proposed method is for the purpose of determining the loss in sound absorption coefficients of the material by painting. Staining of acoustical materials is a major problem with both the manufacturer and the purchaser and it would be of benefit if staining could be retarded or prevented. Therefore, a test method for evaluating the staining propensities of commercial acoustic materials is a desirable development. Much information is needed and considerable research is felt necessary. One example of a cause of staining is ascribed to a phenomenon called breathing. Still other causes are impingement of dirt and thermal precipitation. A special task group was appointed to study the subject thoroughly, beginning with the acquiring of case histories from the various fields of use, especially such Government agencies as the Veterans Administration and the Public Buildings Administration. The term "staining" was questioned, and consideration will be given to the use of some other descriptive term, such as "discoloration." The problem of washability or cleaning of acoustical materials was presented for future consideration.

As a result of previous consideration of the subject of application, and in particular the use of adhesives, the Subcommittee on Application went on record to the effect that further research was needed to establish more pertinent information. Specifically, two things are needed: (*1*) a satisfactory single test method for acoustical adhesives, and (*2*) an adhesive which will have initial strength as well as the required strength after fire exposure. It is felt that more direct participation by adhesive manufacturers was needed in the work of the subcommittee. A task group was authorized to study and present a test method or a program for obtaining the necessary data for a test method.

Reports were presented by several task groups of the Subcommittee on Basic Physical Properties. No progress has been made on the subject of flow resistance due to necessary delays in setting up testing facilities. A light reflectance method has been prepared which will be presented to Committee E-12 for review. The most positive progress has been made in the development of proposed methods for determining the various strength properties of acoustical materials. A group of strength tests will be combined into one proposed method.

The committee plans to hold its next meeting during the 1953 Annual Meeting of the Society in Atlantic City.

Joint Committee on Effect of Temperature Holds December Meeting in New York

The meeting of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals was held in New York City on December 4, 1952.

A progress report of Project 29 on Graphitization will be appended to the 1953 annual report. The work of Project 29 indicated that nitrogen in excess of the minimum amounts found in open-hearth steel served as an inhibitor in the graphitization process. These amounts of nitrogen were on the order of 0.02 to 0.03 per cent.

A report of the Aviation Panel indicated that the first progress report of AP1A may be forthcoming in the near future and will deal with the statistical analysis of creep and creep-rupture properties of a number of steels. The second report of AP2 on thermal shock is also in preparation.

The Gas Turbine Panel reported progress in its studies of notched bars, static rupture tests at 1200, 1300, and 1350 F, and it is expected that the notched bar tensile fatigue tests and the notched bar cantilever tests will be completed in a few weeks. As a result of these tests, serious consideration is being given to a recommended practice for rupture and creep testing. Paul Brister, who has replaced N. L. Mochel as Chairman of the Steam Power Panel, reported continuing activity on the part of task groups SP1 on low chromium-molybdenum alloys for use in steam lines operating at 1000 to 1100 F, SP2 on the elevated temperature properties of cast iron, and SP3 on type 347 welds in steam service.

The Low Temperature Panel has developed a program for a five-session meeting devoted to a "Symposium on Metallic Materials at Low Temperatures." The sessions will be held Sunday evening, June 28; Monday morning, afternoon, and evening, June 29; and Tuesday morning, June 30, in connection with the Annual Meeting of the Society at Atlantic City.

Possibilities for two other symposiums were discussed, one on effect of strength on structural changes at elevated and sub-zero temperatures and one on effects of environment on strength, scaling, embrittlement, and deterioration at elevated temperatures. It was agreed that a symposium on this latter topic, that is, effects of environment, should be held at the 1954 annual meeting and a survey of possible work in this field will be made in an effort to secure appropriate papers.

The activities of the Data and Publications Panel are directed toward a number of planned publications:

Chromium-Molybdenum Alloys.—In reply to a request for information, 14 companies have furnished data relating to the chromium-molybdenum alloys. It is expected that the analysis of these data will be completed in about six to eight weeks. Preparation of figures and typing will take an additional month. It appears that these data may be available about May 1.

Super Alloys.—Although 19 companies have submitted data on the super alloys, many of the data submitted have been in the form of trade brochures, etc. This type of data will be returned and the request made that information be submitted on standard forms. Based on an estimate of the time for analysis and preparation of material in connection with the chromium-molybdenum alloys, it would appear that the data on super alloys will not be ready before August or September.

Relaxation.—The forms for recording relaxation data and accompanying request for assistance in the accumulation of such data were sent out in November.

Copper-Base Alloys.—Solicitation letters and forms requesting data on elevated temperature properties of copper-base alloys will be sent out in the near future.

High-Temperature Strength of Weldments.—There is indication that few data are available concerning the high-temperature strength of weldments. However, a letter will be sent out asking whether data are available and how much, and an analysis of the returns should show whether there are data in sufficient quantity to warrant publication.

It was reported that the total amount received from the various contributors in response to the most recent solicitation of funds, totaled \$70,970 as follows:

Foundry	\$ 8 075
General	15 200
Joint Committee	28 750
Trade Assns.	15 000
Engineering Assns.	3 000
Consulting Engineers	950

Performance Tests Stressed By Wax Polishes Group

THE activity of Committee D-21 on Wax Polishes and Related Materials which has held the most interest to the members, as well as to the industry, has been in the field of performance tests. The slipperiness of a waxed floor has been a very difficult thing to measure but at the meeting of all of the subcommittees of Committee D-21 in New York City on December 10, very encouraging progress was noted in the development of a standard test method for measuring the coefficient of friction.

Two types of apparatus have been under consideration—the James machine, developed at the Underwriters' Laboratories, and the Sigler machine, developed at the National Bureau of Standards. Both pieces of apparatus simulate the action of foot traffic on a floor surface, one the action of the sole of a shoe, and the other the heel. A draft of a proposed test method was reviewed, and after certain revisions were agreed upon, it was approved for letter ballot of the subcommittee. This method of test prescribes procedures for measuring the coefficient of friction of floor surfaces by dynamic and static methods. Correlation of data from test results and field performance is definitely a part of the committee program.

The Subcommittee on Raw Materials agreed upon two proposed methods which will be published for information only at the present time. These methods provide a means of measuring the refractive index of waxes as raw materials and a chemical method of analysis. In chemical and physical testing of floor waxes, four tentative methods were approved by the subcommittee, these covering procedures for measuring sediment, total ash, nonvolatile content, and kinematic viscosity. The last-mentioned procedure involves a suggested revision to an existing ASTM Tentative Standard (D 445 - 46 T). This suggested revision will be presented to Committee D-2 on Petroleum Products and Lubricants which has jurisdiction over the standard.

Mass Spectrometry Committee to Hold Big Papers Session at Pittsburgh Conference

THE first meeting of Committee E-14 on Mass Spectrometry since its organization in March, 1952, will be held in Pittsburgh, March 3–5, in conjunction with the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy. Papers sessions sponsored by the committee will be held in the morning and afternoon on March 3; the afternoon of March 4; and the morning of March 5. The meeting of the committee is scheduled for March 3 at 4:45 p.m.

Listed below are the papers which will be presented at the four sessions. Minor changes may be made in the program, but this is essentially its final form. Later information can be obtained from the Officers of Committee E-14 or from Society headquarters.

Tuesday a. m., March 3

The Detection of Atoms and Free Radicals in Flames by Mass Spectrometric Techniques—S. N. Forrer

Some Ions of High Kinetic Energy in Mass Spectra of Polyatomic Molecules—Fred L. Mohler, V. H. Dibeler, and R. M. Reese

Negative Ion Formation of Sulfur Hexafluoride—Bruce Hannoy

Half-Life of Negative Metastable Ions—B. L. Donnally and H. E. Carr

Ionization and Dissociation by Electron Impact: 1—Butanethiol, 2-Butanethiol, and 3-Methyl-2-Propanethiol—G. L. Cook and J. J. Walsh

Mass Spectrometer Investigation of Higher Valence Uranium Compounds in UF_4—R. Baldock, J. R. Sites, L. O. Gilpatrick, and H. E. Carr

Tuesday p. m., March 3

Accuracy and Reproducibility of Hydrocarbon Analysis in Routine, Plant Control with a Metropolitan-Vickers Mass Spectrometer—B. W. Bradford

A New Monitoring Mass Spectrometer—G. Wilson and A. P. Gifford

The Identification and Determination of Volatile Atmospheric Pollutants—F. W. McTafferty, G. E. Clock, and R. S. Gohlke

A Method for Determination of Values for Nitrous Oxide in Blood with the Mass Spectrometer—F. K. Dietzler, J. Saari, A. Faulconer, and E. J. Baldes

Analysis of Mixtures of the Oxides of Nitrogen and Carbon—H. J. Frey and G. E. Moore

Mass Spectrometric Analysis of Mixtures Containing Nitric Oxide and Dinitrogen Tetroxide—R. A. Friedel, A. G. Sharkey, Jr., J. L. Schultz, and R. C. Humbert

Wednesday p. m., March 4

Mass Spectrometry of Solids—E. J. Serfass

Mass Spectrometric Study of Germanium—R. E. Honig

Mass Spectra of Inorganic Halides—L. Friedman

High-Temperature Mass Spectrometer Oven—J. B. Walton

Mass Dependence of the Gain of an Electron Multiplier from Observations on K-39, Na-23, W-184, and U-238—F. A. White and T. L. Collins

A Reliable Method of Counting Individual Positive Ions in a Mass Spectrometer for Beam Current of Less Than 10^{-15} Ampere—F. A. White, T. L. Collins, and J. C. Sheffield

Thursday a. m., March 5

Analysis of Virgin Petroleum Naphthas by Mass and Infrared Spectroscopy—B. W. Thomes, J. A. Anderson, Jr., A. Elliott, H. E. Lumpkin, and R. B. Williams

Gain Control of Mass Spectrometer Amplifier—S. Meyerson, H. M. Grubb, and W. H. Moeller

Computed Calibration Data for Gas Analysis by Mass Spectrometer—S. Meyerson

Structural Qualitative Analysis from Mass Spectra—J. M. McCrea

Mass Spectrometric Analyses of Six- and Seven- Carbon Alcohols—Y. A. Yarborough

"Abundance Sensitivity," A Figure of Merit for an Isotope Ratio Mass Spectrometer—F. A. White and T. L. Collins

Mass Spectroscopic Studies of Mixtures of Water and Deuterium Oxide—J. L. Warneck

Heat-Capacity Standards

WITH the extension of heat measurements toward the extremes of the temperature scale, the National Bureau of Standards is developing new standards of heat capacity for use at temperatures where water, the present standard substance, cannot be employed. Special samples of benzoic acid, *n*-heptane, and aluminum oxide were prepared and their heat capacities determined over most of the useful temperature range. A limited number of these samples are being made available to laboratories equipped to make very precise measurements of heat capacity.

Recent developments in such fields as low-temperature physics, nuclear engineering, and jet propulsion have made it necessary to extend heat measurements to very high and very low temperatures. While water has served as a standard in the range 0 to 100 C, it is not well suited to use outside this range.

In general it has been found that benzoic acid will serve when a solid is needed at temperatures below 80 C. *N*-heptane can be used up to about 130 C, providing a liquid standard which can be distilled in and out of the calorimeter and which does not expand on freezing (at −90.6 C). Aluminum oxide is unique among these materials in that it can serve as a practical standard in the entire temperature range up to 900 C, and as soon as accurate measurements of its heat capacity are available at higher temperatures, it should be usable up to 2000 C.

Discussion of ASTM Terms Relating to Methods of Testing*

J. T. Richards.[1]—The following suggestions for revision of definitions are offered in response to a request from Mr. McVetty, Chairman of Subcommittee 3, Task Group on Review of Definitions, Committee E-1 on Methods of Testing.[2]

Standard Definitions of Terms Relating to Methods of Testing (E 6 - 36)[3]

Modulus of Elasticity.—Mr. Findley[4] has recommended that "proportional limit" be substituted for "elastic limit" in the definition. Since it is doubtful whether commercial materials have either proportional or elastic limits in the true sense, why employ either as a limiting value in the definition? From a practical standpoint, it is generally desirable to know the elastic modulus at a given stress level or range. Depending upon the material and application, the elastic modulus may be required at stresses well above or below an arbitrarily designated elastic or proportional limit. Therefore, why not cite modulus values qualified by appropriate stresses or stress ranges?

The note to the definition implies that there is a difference between moduli in tension and compression. This is, however, not the case. Experimental data indicate that these two moduli are the same at their only common point—zero stress. At other stress levels, relaxation and variations in diameter may cause a difference that is apparent only.[5]

There is room for improvement in elastic modulus terminology. For instance, the term "modulus of elasticity" sometimes refers to Young's modulus only and in other instances is applied collectively to both shear modulus and Young's modulus. In view of possible confusion resulting from the multiplicity of terms, the following expressions are suggested: E-modulus (for Young's, tension, compression, etc.), G-modulus (for shear, rigidity, torsional, Coulomb's, etc.) or, collectively, as simply elastic moduli.

The versatility and simplicity of this system are evident from the following examples:

E_0-modulus = initial tangent modulus of elasticity or Young's modulus at zero stress,

secant G-modulus = secant modulus of rigidity,

E_D-modulus = dynamic Young's modulus, and

G_S-modulus = static modulus of rigidity.

As suggested by Mr. Findley, secant and tangent moduli should be considered in the definition on account of the possibility of wide variations between these values. This could be easily represented by a suitable diagram.

Elastic Limit and Proportional Limit.—Since the determination of these limits, as defined, is not possible with existing test methods, perhaps some revision is in order. In present practice, these values are dependent upon the sensitivity of our measuring tools. Therefore, for reported values of elastic or proportional limit to have meaning, they should be qualified by the estimated or actual least count of the strain measuring device. The following definitions result:

Elastic Limit.—The greatest stress which a material is capable of developing with a permanent deformation (equivalent to the least count) remaining upon complete release of the stress.

Proportional Limit.—The greatest stress which a material is capable of developing with a deviation (equivalent to the least count) from the law of proportionality of stress to strain (Hooke's law).

As a result, these limits would not be fixed values, but would vary with the test sensitivity. Actually this is what we are doing at present; however, our results do not meet the requirements of the definition. In practice, listing would be similar to the following arbitrary examples:

Proportional limit (0.002 per cent offset) = 100,000 psi

Elastic limit (0.002 per cent permanent set) = 100,000 psi

Although the elastic and proportional limits afford a convenient basis for comparing materials, their usefulness in determining working stresses is limited in view of the marked variations caused by straining rate, holding time, and overstressing.

* The first discussion of this subject appeared in the May, 1952, issue of the ASTM Bulletin, p. 66. Additional discussion is invited. Please address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Development Engineer, The Beryllium Corp. Reading, Pa.

[2] P. G. McVetty, ASTM Bulletin, No. 182, May, 1952, p. 66.

[3] 1949 Book of ASTM Standards, Part 1, p. 1228; Part 2, p. 986; Part 3, p. 1263; Part 4, p. 1213; Part 6, p. 1335.

[4] W. N. Findley, ASTM Bulletin, No. 185, October, 1952, p. 25.

[5] See Fig. 6, J. T. Richards, "An Evaluation of Several Static and Dynamic Methods for Determining Elastic Moduli," Symposium on Determination of Elastic Constants, p. 71, Am. Soc. Testing Mats. (1952). (Symposium issued as separate technical publication, *STP No. 129.*)

1952 Actions on Chemical Analysis of Metals

Holders of copies of the Book of ASTM Methods for Chemical Analysis of Metals should make note of the adoption as standard, without change, of the Tentative Methods for Chemical Analysis of Steel (E 30 - 50 T), covering procedures for boron, beryllium, and tin. The newly adopted procedures are to be made a part of the Standard Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron, which should now be designated as E 30 - 52.

The following editorial changes should be made in the Standard Methods of Sampling Ferro-Alloys (E 32 - 42): Delete the term "low-carbon" wherever it appears in the method for sampling ferrotitanium. Also, in the last paragraph of the method for sampling low-carbon ferrochromium, change the reference to a "420-micron (No. 40) sieve" to read "590-micron (No. 30) sieve."

Calendar of other Society Events

"Long" and "short" calenders will appear in alternate BULLETINS. The "short" calender notes meetings in the few immediate weeks ahead—the "long" calender for months ahead.

American Association of Textile Technologists—Feb. 3, Annual Symposium, Statler Hotel, New York City.

American Road Builders' Assn.—Feb. 8–12, 1953 National Convention, Boston, Mass.

American Institute of Mining and Metallurgical Engineers, Inc.—Feb. 15–19, Annual Meeting, Statler Hotel, Los Angeles, Calif.

AMERICAN SOCIETY FOR TESTING MATERIALS—March 2–6, Spring Meeting and Committee Week, Hotel Statler, Detroit, Mich.

Analytical Chemistry Applied Spectroscopy Conference—March 2–6, Pittsburgh, Pa.

American Chemical Society—March 15–19, 123d National Meeting, Los Angeles, Calif.

National Association of Corrosion Engineers—March 16–20, Conference and Exhibition, Symposia, Hotel Sherman, Chicago, Ill.

American Railway Engineering Association—March 17–19, Annual Convention, Palmer House, Chicago, Ill.

American Society for Metals—March 23–27, Western Metal Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.

Building Officials Conference of America, Inc.—April 6–9, 38th Annual Conference, Baker Hotel, Dallas, Texas.

American Institute of Mining and Metallurgical Engineers, Inc.—April 20–22, National Open Hearth and Blast Furnace, Coke Oven and Raw Materials Conference, Hotel Statler, Buffalo, N. Y.

American Institute of Chemical Engineers—April 26–29, Chem. Institute Canada, Joint Meeting, Royal-York Hotel, Toronto, Canada.

American Society of Mechanical Engineers—April 28–30, Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio.

Association of American Railroads—June 22–26, Annual Meeting of the Mechanical Division, Atlantic City, N. J.

AMERICAN SOCIETY FOR TESTING MATERIALS—June 29–July 3, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

Improvement in the Uniformity of the Accelerated Soundness Test of Coarse Aggregate*

Report by D. O. Woolf[1] to Subcommittee III-e of ASTM Committee C-9

SYNOPSIS

The development of the present standard gradings used in the accelerated soundness test for coarse aggregates is described with an explanation of a reason for the lack of agreement among different laboratories in check tests of the same aggregate. To correct this difficulty the testing of aggregates in single sizes and the use of the "half-size" sieve for the determination of the loss are recommended. With the use of this method, losses of 6 to 9 per cent may be substituted for losses of 10 to 15 per cent as determined by the present method of test in which combinations of individual sizes of coarse aggregates are involved. The immediate revision of specification requirements for coarse aggregate is recommended to insure that material of a known quality will be obtained.

THE first reference to the accelerated soundness test for coarse aggregate in the standardization procedure of the American Society for Testing Materials appears in *Proceedings*, Vol. 28, Part I (1928). In Appendix II of the Report of Committee C-9 on Concrete and Concrete Aggregates, the proposed method of test required 10 small pieces with a total weight of about 1000 g to be immersed in a saturated solution of sodium sulfate at 70 F for 20 hr and then dried at 100 C for 4 hr. The treatment was to be repeated a specified number of times. Although the operation of immersing, heating, reimmersing, and reheating was required to be continuous, the proposed method also permitted the specimen to cool to approximately the temperature of the solution before it was reimmersed.

No other mention of the method appeared until 1931. Although the reports of Committee C-9 for 1929, 1930, and 1931 were silent with respect to the method, it is apparent that considerable work must have been done in studying and improving the procedure, as a tentative method was published in the 1931 *Proceedings* under the designation of C 89 - 31 T.[2] In many respects the provisions of this tentative method are essentially the same as are specified in the most recent (1946) revision.[3]

The 1931 tentative method required that the coarse aggregate be separated and tested in the following sizes:

Size (Square Openings)	*Minimum Weight, g*
No. 4 (0.185 in.) to 3/8 in.	100
3/8 to 3/4 in.	300
3/4 to 1 1/2 in.	1500
1 1/2 to 2 1/2 in.	3000
Larger sizes by 1 in. spread in sieve size	3000

Why these sizings were selected is not known but it appears that use of the so-called fineness modulus sieves was considered desirable. However, the largest size does not include the 3-in. sieve as required in the fineness modulus series. It is possible that a difference in size of 1 in. between the two sieves used to prepare material for the test was considered to be as great as would be desirable.

Difficulties in obtaining check results of soundness tests between different laboratories and even in the same laboratory were the general rule. Possibly in an attempt to correct this, the grading of the sample was more closely defined in a revision of the method approved in 1941. In this revision the same sizes of coarse aggregate as shown in the 1931 revision were used, but each of the three sizes between the $\frac{3}{8}$- and $2\frac{1}{2}$-in. sieves was separated into a coarse and a fine fraction, and these fractions recombined in a prescribed ratio. Furthermore, some of the minimum weights were increased. The $\frac{3}{8}$- to $\frac{3}{4}$-in. size, for example, was required to weigh at least 1000 g, and to contain 33 per cent of $\frac{3}{8}$- to $\frac{1}{2}$-in. aggregate, and 67 per cent of $\frac{1}{2}$- to $\frac{3}{4}$-in. aggregate. The requirements for the composition of the sample tested are given below:

Size (Square Openings)	*Minimum Weight, g*
No. 4 to 3/8 in.	300
3/8 to 3/4 in.	1000
33 per cent 3/8 to 1/2 in.	
67 in. per cent 1/2 to 3/4 in.	
3/4 to 1 1/2 in.	1500
33 per cent 3/4 to 1 in.	
67 per cent 1 to 1 1/2 in.	
1 1/2 to 2 1/2 in.	300
50 per cent 1 1/2 to 2 in.	
50 per cent 2 to 2 1/2 in.	
Larger sizes by 1-in. spread in sieve size, each fraction	3000

The sizings established in this revision did not prove to be satisfactory as many aggregates used in concrete did not contain material larger than 2 in., but did contain enough of the $1\frac{1}{2}$ to 2-in. size to necessitate that this size be tested to obtain a knowledge of the soundness of the aggregate. Considerable confusion developed regarding the sample to be prepared for test. Some laboratories ignored the requirement that the sample should contain some 2 to $2\frac{1}{2}$-in. material. Since it was not present in the aggregate intended for use, it could not be tested. These laboratories then tested the $1\frac{1}{2}$ to 2-in. size. Other laboratories adhered more closely to the requirements of the specifications, and did not test any material of the $1\frac{1}{2}$ to $2\frac{1}{2}$-in. size if there was no material present larger than 2 in. Consequently check tests between laboratories failed to show satisfactory results and the method of test was repeatedly condemned as unsatisfactory.

USE OF ALTERNATE GRADINGS

To alleviate some of the troubles found, a second grading for the preparation of a sample for the soundness test was adopted in 1946. In this grading which was described as alternate A, the major sizings of the sample were No. 4 to $\frac{1}{2}$ in., $\frac{1}{2}$ to 1 in., and 1 to 2 in., with larger sizes having a spread in sieve size of 1 in. Each of the $\frac{1}{2}$ to 1-in., and 1 to 2-in. sizes was separated into a coarse and a fine fraction by the use of the $\frac{3}{4}$ in. or $1\frac{1}{2}$-in. sieves, and these fractions recombined in a prescribed ratio to prepare the sample to be tested. The requirements for the composition and weight of this alternate A sample are given:

Size of Piece	*Minimum Weight, g*
No. 4 to 1/2 in.	300
1/2 to 1 in.	1500
33 per cent 1/2 to 3/4 in.	
67 per cent 3/4 to 1 in.	
1 to 2 in.	3000
50 per cent 1 to 1 1/2 in.	
50 per cent 1 1/2 to 2 in.	
Larger sizes by 1-in. spread in sieve size, each fraction	3000

* This report was submitted to Subcommittee III-e on Methods of Testing Concrete Aggregates for Physical Characteristics of Committee C-9 on Concrete and Concrete Aggregates. Because of its general interest to the entire field of Concrete Aggregates, it was submitted for publication. Comments should be addressed to the Society.

[1] Senior Materials Engineer, Physical Research Branch, Bureau of Public Roads, Department of Commerce, Washington, D. C.

[2] Methods C 88 for fine aggregate and C 89 for coarse aggregate were combined and identified as C 88 in 1937.

[3] Tentative Method of Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate (C 88 - 46 T), 1949 Book of ASTM Standards, Part 3, p. 776.

For some reason which was not stated the No. 4 to $\frac{1}{2}$-in. size was not subdivided on the $\frac{3}{8}$-in. sieve.

At the same time, another grading was adopted for use when it was desired to test coarse aggregate in narrower ranges of size than was provided by the two gradings mentioned above. This grading was identified as alternate B and required the use of the following sizes of piece and minimum weight of sample:

Size	Weight, *g*
No. 4 to $\frac{3}{8}$ in.	300
$\frac{3}{8}$ to $\frac{1}{2}$ in.	500
$\frac{1}{2}$ to $\frac{3}{4}$ in.	750
$\frac{3}{4}$ to 1 in.	1000
1 to $1\frac{1}{2}$ in.	1500
$1\frac{1}{2}$ to 2 in.	2000
Larger sizes by 1 in. spread in sieve size, each fraction	3000

Since the three gradings for preparing the test sample are equally standardized with respect to the ASTM method, some confusion may develop if one is designated in this paper as the "standard." However, since two of the gradings are identified as alternate A and alternate B, the third will be identified here as grading 1.

Determination of Loss in Test

In the quantitative examination of the material after the test, the 1946 revision of the method required that "each fraction of the sample shall be . . . sieved over the same sieve on which it was retained before the test." It is very surprising that criticism of this requirement has not been made before now. The requirement states explicitly that the same sieve used to prepare any size of material in the sample shall also be used to determine the loss of that size of material. And for years laboratories apparently have been making the accelerated soundness test incorrectly. For example, in aggregate prepared according to grading 1, the $\frac{3}{4}$ to $1\frac{1}{2}$-in. size is to contain 33 per cent of $\frac{3}{4}$ to 1-in. pieces, and 67 per cent of 1 to $1\frac{1}{2}$-in. pieces. The prescribed method appears to indicate that these two sizes are to be combined and tested as one portion of the sample, and that the material after treatment is to be sieved on the $\frac{3}{4}$-in. sieve. However, this is not in accordance with the provisions of section 7(*b*) of the method, which as stated above, requires each *fraction of the sample* to be sieved on the *same sieve* on which it was retained before test. This would require the $\frac{3}{4}$ to 1-in. fraction to be sieved on the $\frac{3}{4}$-in. sieve, and the 1 to $1\frac{1}{2}$-in. fraction to be sieved on the 1-in. sieve not on the $\frac{3}{4}$-in. sieve as laboratories now do.

The difficulty here centers around the interpretation of the word "fraction." If a fraction of a sample is that portion which is prepared to size separately from other portions, then the testing of a combination of fractions as shown in grading 1 or alternate A is definitely not in accordance with the provisions of the method. If a fraction is a portion which is tested separately from other portions, then a subdivision of that portion by sieve size should be specifically indicated in the provisions of the method. In a summary of operating practices, it appears that most laboratories violate the provisions of the specifications by testing combinations of fractions as required by grading 1 and alternate A, and determine the loss of the $\frac{3}{4}$ to $1\frac{1}{2}$-in. size, for example, on the $\frac{3}{4}$-in. sieve.

The availability of the three gradings mentioned above for preparation of the test sample failed to improve the situation with respect to more uniform check test results. In some cases, even poorer concordance between check test results was found as one laboratory might use the grading 1 while another might use alternate A or B for the same material under test. The poor agreement between check tests became so marked that the retention of the accelerated soundness test was questioned.

Use of "Half-Size" Sieve

Suggestions for improvement of the reproducibility of the results of the accelerated soundness test have been many and varied. Practically all details of the method have been studied and changes suggested or made except those regarding the determination of the loss. Some comment has been made regarding this, but the suggestions have either been brushed aside or ignored altogether. It must be admitted that these suggestions may not have been supported by data, but the same situation has occurred with respect to other details of the method of test where modification or correction has been made. It is apparent that preconceived opinions or blind adherence to established procedures, however faulty, have been permitted to deny consideration of certain desirable changes.

Some years ago, the suggestion was made that the loss in a soundness test be determined with a sieve having openings one half the size of the sieve on which the sample was initially retained. This suggestion has three excellent features. It will permit a nominal variation between sieves used by different laboratories in the preparation of the test sample, and will not require an excessively meticulous separation by size and minute attention to particles of flat or elongated shape. Secondly, some pieces of the test sample may suffer minor flaking or chipping of corners and edges due to handling during the test procedure. At the completion of the test, these pieces may be found to pass the initial retaining sieve although they are structurally sound, and would be included, quite incorrectly, in the loss. If the "half-size" sieve were used, these pieces would not be included in the loss. Finally, the material passing the "half-size" sieve after the test would unquestionably be material which had suffered multiple cracking or disintegration during the procedure. It would be material which actually was unsound, rather than material which had minor chipping or flaking, or splitting due to incipient fractures developed in the crushing or handling of the aggregate at the plant.

Although it may be known to relatively few, the use of the "half-size" sieve to determine the loss is permitted as an optional method by the 1941 and subsequent revisions of the method. Here again reference is made to each fraction of the sample, and the conflict between the various provisions of the method is not clarified.

Optional Procedures

With exact observance of the several optional provisions of the method, a sample of coarse aggregate can be tested only if the material is prepared as shown for the alternate B grading. The loss can be determined either with the initial retaining sieve, or with a sieve having openings one-half the size of those in the initial retaining sieve. For each sample tested, the loss reported may correctly be either of two values which in all probability are quite different numerically. However, if recognition is given to the customary use of grading 1, and the combination of two sizes is sanctioned, then the provisions of this method could be followed to furnish two more separate test values which might differ greatly but would be equally acceptable with regard to the method. The values obtained by the testing of samples prepared with grading 1, or the alternate A grading, are probably nearly the same and for the purpose of this discussion will be considered identical. Under the provisions of ASTM Method C 88, test values obtained by use of the following gradings and methods of determining the loss are equally standardized:

1. Samples prepared as shown for grading 1 (or alternate A), and the loss determined by use of the initial retaining sieves.
2. Samples prepared as above, and the loss determined by use of the "half-size" sieves.
3. Samples prepared as shown for the alternate B grading and the loss determined by use of the initial retaining sieves.

4. Samples prepared as shown for the alternate B grading, and the loss determined by use of "half-size" sieves.

Collection of Test Data

As little information was available to show the effect of the use of the "half-size" sieve in the determination of the loss, it was decided to collect such information during the course of routine testing of aggregates in the laboratories of the Bureau of Public Roads. To obtain this information, the samples were prepared with the alternate B grading, and subjected to five cycles of the tests using sodium sulfate. After the test each size of aggregate was sieved on the initial retaining sieve, on a sieve having openings one half the size of those in the initial retaining sieve, and on the sieve to be used if the combination of sizes shown in grading 1 were followed. Some sizes were sieved on only two sieves as the initial retaining sieve and the sieve required for use with grading 1 were the same. For example, in the ¾ to 1½-in. size as shown in grading 1, the ¾ to 1-in. portion was sieved to determine the loss on the ¾-in. sieve (initial retaining) and the ⅜-in. sieve ("half-size"). The 1 to 1½-in. portion was sieved on the 1-in. sieve (initial retaining), the ¾-in. sieve (required by grading 1), and the ½-in. sieve ("half-size").

During the period 1946 to 1951, accelerated soundness tests were made on a large number of samples. Of these, 64 samples of rock or gravel had losses of about 5 per cent or more when the loss was determined by the method used with grading 1. These samples are believed to be sufficient in number to furnish data from which a suitable appraisal of the effect on the specification requirement caused by the use of the several methods may be made.

The results of these tests are given in Table I. The identity of the samples, the size tested, and the loss as determined by three of the four procedures given in ASTM Method C 88 are shown. The loss for samples prepared with grading 1 was not determined using sieves with openings one half the size of those in the initial retaining sieves. Some of the samples were crushed in the laboratory from ledge rock and these

TABLE I.—ACCELERATED (Na_2SO_4) SOUNDNESS TEST.
Effect of different methods of determining and computing loss.

Laboratory	Type of Material	Lithological Composition[a]	Size Tested	Loss in Test, per cent: Grading 1 with Initial Retaining Sieves	Alternate B grading: With Initial Retaining Sieves	Alternate B grading: With "half-Size" Sieves
No. 71597......	Rock	Limestone	1½ in. to No. 4	7.0	9.0	4.2
No. 71736......	Rock	Limestone	1 in. to No. 4	6.5	7.0	1.8
No. 71748......	Rock	Limestone	1½ in. to No. 4	5.5	7.8	2.8
No. 71749......	Rock	Granite	1½ in. to No. 4	5.8	6.8	3.8
No. 71783......	Rock	Serpentine	1½ in. to No. 4	28.4	42.8	15.0
No. 71797......	Rock	Amphibolite	1½ in. to No. 4	6.3	7.2	4.6
No. 71798......	Rock	Amphibolite	1½ in. to No. 4	5.5	6.5	4.1
No. 72010......	Rock	Conglomerate	1½ in. to No. 4	26.0	34.5	14.7
No. 72012......	Rock	Schist	1½ in. to No. 4	11.9	18.9	6.2
No. 72023......	Rock	Sandstone	1½ in. to No. 4	9.3	11.7	6.5
No. 72039......	Rock	Sandstone	1½ in. to No. 4	10.6	14.7	5.4
No. 72045......	Rock	Diorite	1½ in. to No. 4	6.6	8.4	3.2
No. 72076......	Rock	Sandstone	1½ in. to No. 4	26.1	36.1	11.5
No. 72079......	Rock	Sandstone	1½ in. to No. 4	13.0	16.4	10.3
No. 72080......	Rock	Sandstone	1½ in. to No. 4	69.4	73.8	62.6
No. 72089......	Rock	Granite	1½ in. to No. 4	10.8	12.4	7.6
No. 72119......	Gravel	Q Qz C	1½ in. to ¾ in.	8.8	11.1	5.3
No. 72120......	Gravel	Q Qz C	2½ in. to ¾ in.	8.9	9.5	5.5
No. 72226......	Rock	Limestone	1½ in. to No. 4	9.1	15.0	5.6
No. 72227......	Rock	Limestone	1½ in. to No. 4	25.6	30.9	16.7
No. 72229......	Gravel	L D Qz C	1½ in. to No. 4	11.6	16.5	7.6
No. 72231......	Rock	Limestone	1½ in. to No. 4	12.9	19.2	6.2
No. 72368......	Gravel	Q Qz S	1½ in. to No. 4	7.8	8.6	4.2
No. 72452......	Rock	Chert	1½ in. to No. 4	5.0	6.2	2.7
No. 72454......	Rock	Sandstone	1½ in. to No. 4	11.4	18.6	6.3
No. 72455......	Rock	Sandstone	1½ in. to No. 4	57.7	66.7	53.9
No. 72480......	Rock	Schist	1½ in. to No. 4	6.1	7.6	4.9
No. 72516......	Rock	Limestone	1½ in. to No. 4	5.1	7.2	2.5
No. 72517......	Rock	Limestone	1½ in. to No. 4	10.5	14.3	5.0
No. 72518......	Rock	Sandstone	1½ in. to No. 4	15.7	18.6	11.1
No. 72529......	Rock	Sandstone	1½ in. to No. 4	36.9	40.0	27.8
No. 72621......	Rock	Limestone	1½ in. to No. 4	8.6	10.1	5.1
No. 72717......	Rock	Sandstone	1½ in. to No. 4	9.1	12.8	5.5
No. 72781......	Rock	Sandstone	1½ in. to No. 4	37.8	46.1	33.5
No. 73252......	Gravel	L Qz A	2 in. to No. 4	29.6	37.6	21.3
No. 73253......	Gravel	L S	2 in. to No. 4	20.4	27.0	14.0
No. 73465......	Rock	Schist	1½ in. to No. 4	6.6	8.3	4.3
No. 74155......	Gravel	Igneous	1½ in. to No. 4	26.4	30.1	19.9
No. 74156......	Gravel	R L S G	1½ in. to No. 4	13.5	17.8	10.0
No. 74158......	Gravel	O R S	1½ in. to No. 4	7.4	9.2	4.9
No. 74159......	Gravel	O R	1 in. to No. 4	13.2	16.2	7.8
No. 74177......	Rock	Limestone	1½ in. to No. 4	4.7	6.1	2.4
No. 74422......	Rock	Andesite	1½ in. to No. 4	50.5	55.5	45.0
No. 74426......	Gravel	Igneous	2 in. to No. 4	11.0	12.2	8.9
No. 74429......	Gravel	Igneous	2 in. to No. 4	6.5	6.9	5.0
No. 74458......	Rock	Schist	1½ in. to No. 4	7.8	9.9	6.0
No. 74763......	Rock	Limestone	1½ in. to No. 4	6.1	9.6	2.0
No. 74495......	Rock	Schist	1½ in. to No. 4	3.9	5.8	1.8
No. 75000......	Gravel	Chert	1½ in. to No. 4	6.0	9.7	2.2
No. 75154......	Gravel	Chert	2 in. to No. 4	5.7	6.6	4.3
No. 75212......	Gravel	Chert	1½ in. to No. 4	8.4	11.7	3.2
No. 76270......	Gravel	Q Qz C	1½ in. to No. 4	6.7	7.6	3.7
No. 76271......	Gravel	Q Qz C	2½ in. to No. 4	6.9	10.0	6.2
No. 76705......	Gravel	C Q	1½ in. to No. 4	12.5	15.4	6.9
No. 76887......	Gravel	C	1½ in. to No. 4	6.0	7.9	2.7
No. 81225......	Rock	Limestone	1½ in. to No. 4	9.8	13.9	4.5
No. 81365......	Rock	Dolomite	1½ in. to No. 4	6.0	9.2	2.2
No. 81762......	Rock	Limestone	2 in. to No. 4	20.4	26.7	4.1
No. 81763......	Rock	Limestone	2 in. to No. 4	22.5	27.9	13.0
No. 81797......	Rock	R Sc Q	1 in. to No. 4	17.6	25.2	12.7
No. 81798......	Rock	Granite	1 in. to No. 4	16.1	28.5	10.7
No. 81799......	Rock	Schist	1 in. to No. 4	7.6	15.5	4.4
No. 82107......	Rock	Gneiss	1½ in. to No. 4	9.8	12.0	4.6
No. 82108......	Rock	Diabase	1½ in. to No. 4	6.7	8.3	2.6

[a] A = Andesite, C = Chert, D = Dolomite, G = Granite, L = Limestone, O = Obsidian, Q = Quartz, Qz = Quartzite, R = Rhyolite, S = Sandstone, Sc = Schist

were assumed to have a uniform gradation between the No. 4 and $1\frac{1}{2}$-in. sieves with equal amounts retained on the 1, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{3}{8}$-in., and No. 4 sieves. This assumption was necessary in the computation of an average loss weighted with respect to grading as was done for the naturally graded aggregates included in the tests. The results shown in the table as grading 1 were computed in accordance with the procedure given in the first portion of paragraph 4(*b*) of ASTM Method C 88. The loss for the $\frac{3}{8}$ to $\frac{3}{4}$-in. aggregate was determined by use of the $\frac{3}{8}$-in. sieve, and that for the $\frac{3}{4}$ to $1\frac{1}{2}$-in. material was determined by use of the $\frac{3}{4}$-in. sieve. A few samples were prepared and tested according to the procedure specified for alternate A grading. The values obtained are included with those for grading 1.

Comparisons of the losses as determined by the procedure for grading 1, and as determined by the procedure for grading B using both the full-size and "half-size" sieves, are shown in Fig. 1. Samples which had losses for grading 1 greater than 30 per cent or greater than 35 per cent for grading B are not shown in the figure.

Relations Shown by Test Data

The curves in the figure show that when the alternate B grading is used, the loss will be somewhat greater or somewhat less than that obtained with grading 1, depending upon whether the initial retaining sieves or "half-size" sieves are used to determine the loss of the alternate B sample. When the initial retaining sieves are used, the loss for grading B varies directly with that for grading 1, and is very nearly equal to 1.35 times the loss for grading 1. When the "half-size" sieves are used, the loss for a more durable material is low in comparison with that obtained through the use of grading 1. This indicates strongly that the loss for grading 1 may be due to a considerable extent to the passage through the initial retaining sieve of pieces of aggregate which have suffered only minor chipping and flaking and are basically sound.

The principal interest in these relationships is in the lower portion of each curve. Most specifications for coarse aggregate permit the material to have a loss of 10 to 15 per cent when tested in accordance with Method C 88. For the purpose of this discussion, it is assumed that the intent of these specifications is to have the aggregate prepared for test using grading 1 or the alternate A grading, and the loss determined using the major sieve-size divisions shown for each of these gradings. However, if reference to the method is made only by the ASTM designation, the test could be conducted using the alternate B grading, and the loss could be determined using the original retaining sieves or sieves having openings one-half the size of those in the original retaining sieves. And as previously mentioned, a fourth option is also permitted by the present inexact wording of the method: the use of grading 1 or the alternate A grading, and the determination of the loss with "half-size" sieves.

As mentioned above, no data are available showing the values obtained when grading 1 and "half-size" sieves are used. The relationships shown in Fig. 1 permit comparisons of the effect of the use of the other three procedures allowed by the method as now written. An aggregate tested with grading 1 and found to have a loss of 12 per cent would have a loss of about 16 per cent if tested with the alternate B grading and the initial retaining sieves, or a loss of about 7 per cent if tested with alternate B grading and "half-size" sieves. Since the procedures cited are equally standardized with respect to Method C 88, it follows that one laboratory could test the aggregate using the alternate B grading and the "half-size" sieves, and certify the material to meet a specification requirement of 12 per cent loss, while another laboratory would find a loss of 19 per cent by testing the same material and using grading 1 and the original retaining sieves. On the other hand, if the material were tested with grading B and the original retaining sieves, a loss of about 12 per cent would be found for material which with grading 1 would have a loss of 9 per cent.

Recommended Action

This is an awkward situation for a method of test which has such a wide use as this one has. It is necessary that the method be corrected immediately to afford a single procedure for the preparation of the sample and the determination of the loss so that a specification requirement for soundness will have a definite meaning. The use of combinations of sizes as now shown for grading 1 and alternate A is faulty in that neither grading can be used for all coarse aggregates which are specified for concrete. The procedure specified for use with grading 1 and alternate A are faulty in that the sieves to be used in determining the loss of the sample are not precisely stated. It would be highly desirable to discard these two gradings and replace them with a grading which will be applicable to any size of coarse aggregate.

Such a grading is available in that now shown as alternate B. With its use, there could be no uncertainty of the method of preparation of the sample, and specification requirements would have a definite meaning. Coupled with the use of these single sizes of aggregate should be the determination of the loss with a sieve having openings one-half the size of those of the original retaining sieve. The advantage of the use of the "half-size" sieves has been mentioned above.

Most specifications for coarse aggregate for use in concrete and some for coarse aggregate for use in bituminous construction permit the aggregate to have a loss in the accelerated soundness test of 10 to 15 per cent when sodium sulfate is used. These values probably were established on the basis of experimental work with the method when there was only one grading of material permitted for use in the test, as in the 1931 and 1944 revisions. Consequently, these values would definitely not apply to the loss obtained with the use of grading B and "half-size" sieves. As shown in Fig. 1, losses of 5.8, 7.1, and 9.2 per cent with grading B and the "half-size" sieves would agree with losses of 10, 12, and 15 per cent as previously determined.

The use in the accelerated soundness test of a grading for the test sample which is applicable to the grading of all coarse aggregates used in concrete, and the use of the "half-size" sieves to determine the portion of the sample which has suffered disintegration or multiple cracking, are recommended for immediate adoption. Until such time as the method of tests can be rewritten and published, it is recommended that specifications for coarse aggregate be revised to permit a loss of 6, 7, or 9 per cent, in agreement with the former requirement of 10, 12, or 15 per cent, respectively. It is further recommended that reference to the method of test be given with specific mention of the alternate B grading shown in Section 4(*b*),

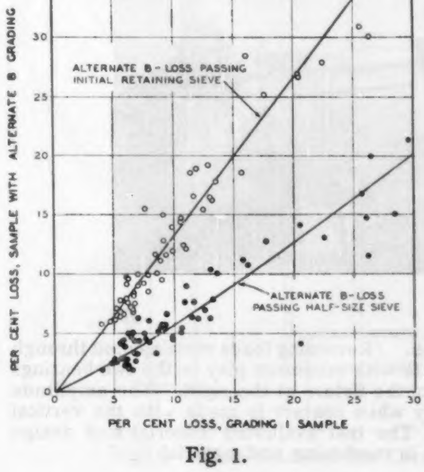


Fig. 1.

and the determination of the loss using the "half-size" sieves described in Section 7(*c*) of Method C 88. If these recommendations are followed, it is believed that the method as revised will furnish more reliable test results than have been obtained, and that an acceptance value of, say, 7 per cent with the revised method will identify undesirable aggregates more definitely than an acceptance value of 12 per cent as now used. With the revised method, the requirements of the specification for coarse aggregate will have a positive meaning, and the concordance of test results obtained by different laboratories should be improved to a marked extent.

Simulated Service Test Fixtures Illustrated

IT IS often practically impossible to analyze theoretically or photoelastically the involved three-dimensional arrangements of stresses. To set up tests for materials and machine parts in such a way as to simulate the stress conditions under which the material, machine part, or structural element operates, sometimes taxes engineering ingenuity. On the other hand, in spite of frequent apparent necessity for complexity in designing fixtures for simulated service tests, most of such fixtures have turned out to be simple.

Simulated service test fixtures have been designed for such diverse fatigue testing as rubber mounts for motor car and truck engines, wrist pin and connecting members in a piston and connecting rod assembly, bearings, airplane parts, gears, textile machine parts, steering spindles for automobiles, trucks, and tractors, and adding machine parts.

Several of these simulated fatigue test fixtures are shown in Figs. 1, 2, 3, and 4.

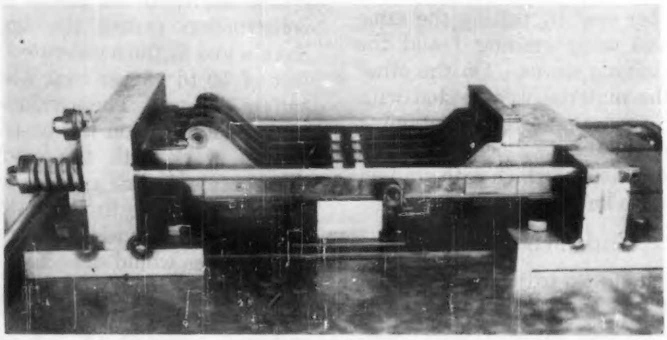


Fig. 1.—Simple fixtures at each end of a shuttle box hold it while repeated bending loads are applied vertically at the middle of the span. (Tie rods and compression springs maintain a compression load of 1000 lb during the test.)

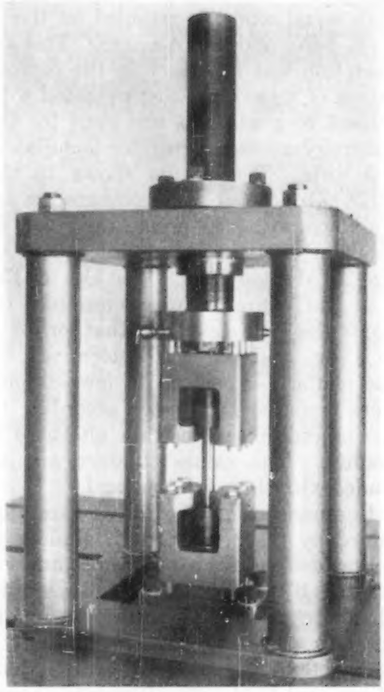


Fig. 2.—Fixtures for applying alternating tension and compression in a test bar. (In this instance the frame of the fixture surrounds the platen of a fatigue machine. It consists of heavy steel plates and four tubular supporting columns. The upper grip is supported by a heavy threaded bar and the whole assembly is designed to avoid resonant harmonics of the vibration frequency of the platen.)

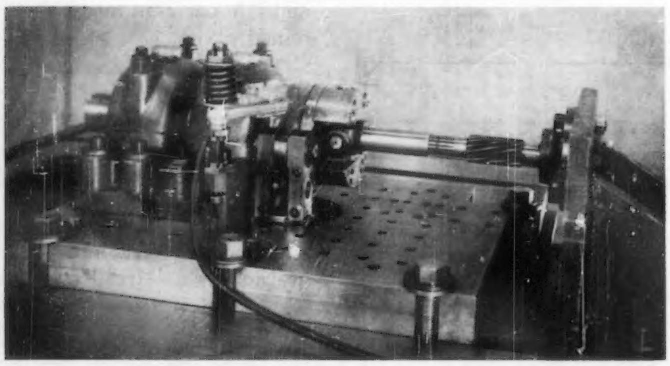


Fig. 3.—Fatigue tests of universal joint knuckles. (Reversing loads were applied through needle-bearing shackles to a shaft free to rotate with minimum play in the two bearings at the left. The connecting shaft was bolted to the fixture at the right. The amplitude limiting device in front operates automatically when contact is made with the vertical shackles that apply the reciprocating load. The test evaluated material and design changes which produced savings in machining and material.)

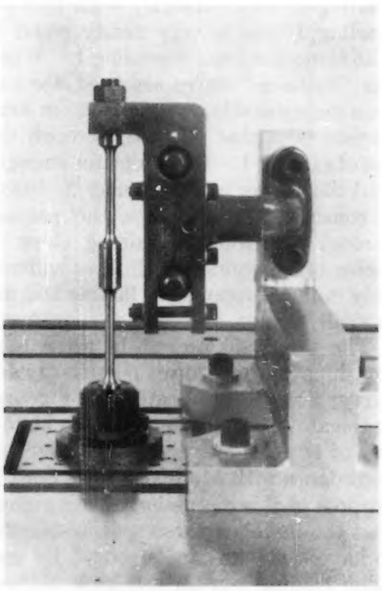


Fig. 4.—Fatigue testing a tractor shifting lever. (The fixture is made in such a manner that both bending and torsional stresses are the same as those exerted in service.)

The General Motors Research Corrosion Test: A Cyclic Humidity Accelerated Corrosion Test for Sheet Steel*

By A. J. Opinsky, R. F. Thomson, and A. L. Boegehold[1]

SYNOPSIS

A new type of precision corrosion test has been developed to study the corrosion resistances of bare steel specimens for those applications where the protective rust of specimens exposed on racks outdoors is not fully realized. A slow humidity cycle, an elevated temperature, and a superimposed dip of a weak electrolyte have been so arranged that an almost nonprotective rust is developed after an initial period. There is evidence that this test rates several steels in about the same order as atmospheric exposure testing. The magnitude of corrosion losses of steels exposed to this test is about three times that of the same steels exposed to a modified ASTM salt-spray test[2] (salt concentration 5 per cent by weight) for the same length of time.

SERVICE testing is the best procedure for evaluating the corrosion resistances of materials. However, this method has the distinct disadvantage that the strict control of variables may be difficult or impossible; second, a long time is required to obtain the answers. As a substitute, carefully controlled outdoor exposure tests may give better variable control, but the length of time required is still a definite drawback. Moreover, the worst conditions of automotive corrosion occur in sheltered areas, such as in rocker panels and inside doors, where the steel remains wet for long periods of time. Apparently the rust formed under these conditions is not so protective as that developed on outdoor exposure specimens. Hence the objective of this investigation was the development of a test which more closely approximated these conditions than did atmospheric exposure. Therefore an accelerated test was developed with the specific idea of minimizing the formation of a protective rust; this test would select the more promising steels for a further program involving service testing.

Furthermore, an accelerated test can be made precise and reproducible by the close control of variables. A precise test is desired because undoubtedly it will be called upon to differentiate between materials which have very close to the same corrosion resistances. The test must be reproducible because the evaluation of all materials during one test would be impossible, and reasonable assurance must be had that the conditions of test do not vary much from test to test.

The variables which have been accentuated to obtain this accelerated test have, for the most part, been held within conditions which could possibly be found in service. Bare steel can reach a temperature of 125 F in the atmosphere; this is the temperature of test. Every day at least one humidity cycle occurs naturally. These two variables occur generally and have stayed within the limitations stated above. The use of a dilute electrolyte solution is peculiar to the present application of the test. This test is used for the evaluation of the resistances of various automotive steels to an atmosphere which is composed in part of salt-filled slush generated on the streets of some cities during the winter. Therefore, a dilute solution of sodium and calcium chloride is used as the dip solution; again the relative strengths are such as are encountered occasionally in service. A small amount of sulfuric acid has been added to the dip solution to adjust partially for the sulfur compounds in the atmosphere.

TESTING PROCEDURE

Specimen Preparation:

The specimen is $1\frac{1}{2}$ in. wide by 3 in. long by about 0.030 to 0.040 in. thick. One hole is punched $\frac{3}{8}$ in. from each of the short sides to permit the specimen to be supported. Six to eight duplicate specimens are chosen from the various steels to be tested. In addition, standard steels are included in each test to ascertain the reproducibility of the test. Next the surface areas of the specimens are measured by means of a planimeter. The specimens are then cleaned electrolytically in trisodium phosphate at 160 to 180 F. The removal of grease by this process is advantageous from the standpoint of the precision of the test. The specimens are weighed and placed on plain glass rods and a coated metal rack in such a manner that they are about 1 in. from one another.

Testing:

Simultaneously the test apparatus has been brought to the proper conditions for the start of the test. Apart from the brief description of the apparatus given here, some additional

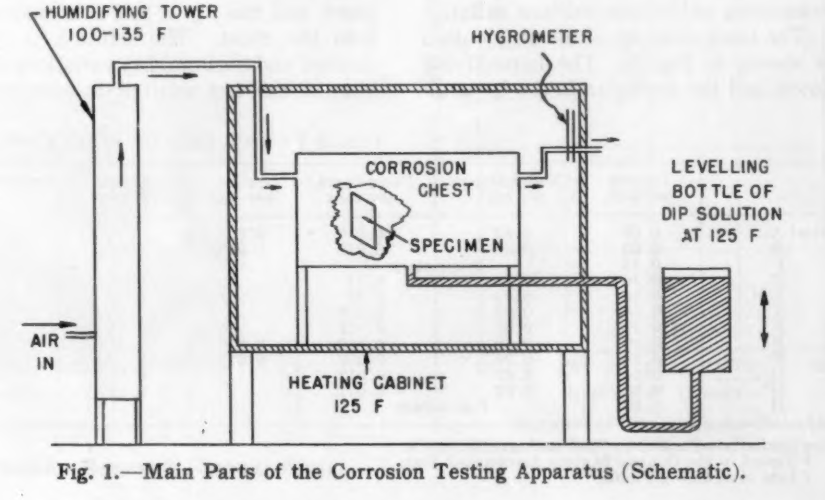


Fig. 1.—Main Parts of the Corrosion Testing Apparatus (Schematic).

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

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[2] Tentative Method of Salt Spray (Fog) Testing, 1949 Book of ASTM Standards, Part 2, p. 786; Part 4, p. 505.

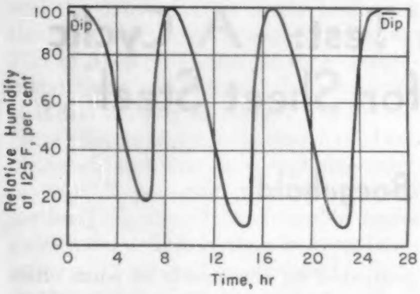

Fig. 2.—Humidity Cycle (Schematic) of the GMR Accelerated Test.

information on the electrical control circuit will be found in the Appendix. Figure 1 shows four of the five main parts of the apparatus: The humidifying tower, the heating cabinet, the corrosion chest, and the dip mechanism. Not shown is a drying train which is used on part of the cycle.

A cyclic variation of humidity is obtained basically by the variation of the temperature of the water in the humidifying tower. The temperature of the water is cycled thermostatically between limits such that the relative humidity of air bubbling through the water will vary between about 50 and 100 per cent when the air is brought to 125 F. Extension of the range of relative humidity is accomplished by adding a drying period to the basic humidity cycle described above. The relay circuit (see Appendix) is so arranged that the drying period is switched on when the relative humidity has descended to about 50 per cent. The length of the drying period has been 3 hr; the entire cycle takes about 8 hr. The lowest relative humidity regularly obtained is about 8 to 10 per cent and the highest is 100 per cent. Figure 2 portrays the cycle schematically.

The drying train, through which the air is switched during the drying period, has a concentrated sulfuric acid bubbler for primary dehumidification. The secondary stage is a desiccating tower containing anhydrous calcium sulfate.

The block diagram of air distribution is shown in Fig. 3. The humidifying tower and the drying train are in parallel, with the solenoid valves switching the air flow through one or the other.

The corrosion chest is a coated stainless-steel box within which the specimens are corroded. It is surrounded by a wooden heating cabinet which is thermostatically maintained at 125 ± 2 F. This 125 F temperature is an accentuated variable leading to the acceleration of the test; *it has been held constant during the testing procedure.* The air leaving the chest passes through a wet and dry bulb hygrometer used to show gross variations in the relative humidity.

The dipping device is essentially a leveling bottle operating through a drain in the bottom of the corrosion chest. By such a method very few extraneous variables are introduced into the test by the dip. The dip solution is heated to 125 F to prevent cooling the chest. The concentration of the solution is 1 per cent sodium chloride, 1 per cent calcium chloride, and 0.1 per cent sulfuric acid by weight. For the first dip, the solution is siphoned into the corrosion chest and allowed to stand for about 25 min and then drained. On each succeeding workday during the test, the daily dip is accomplished at that point in the humidity cycle where the relative humidity is close to 100 per cent (the short horizontal line marked dip at about 25 hr on Fig. 2) to decrease the perturbation of the cycle due to the dip. After the solution has been siphoned in and has remained in the chest for 5 min, almost all of it is drained and replaced three times to provide a washing action. Finally the solution is drained. This operation takes about 20 to 25 min per day.

The proper conditions for the start of the test are such that the test cycle will not be disturbed greatly; for example, the cabinet should be at 125 F and the relative humidity within the corrosion chest should be about 100 per cent. At this time the rack of specimens previously prepared is placed in the corrosion chest and the dip solution is siphoned into the chest. The solution is later drained and the humidity variations then control the test until it is completed.

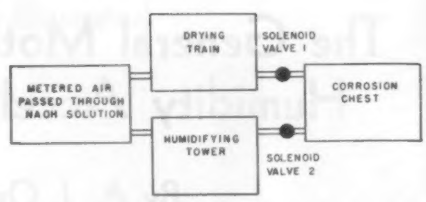

Fig. 3.—Block Diagram of Air Distribution in GMR Accelerated Test.

The chest is preferably kept shut for the remainder of the test to prevent the introduction of extraneous variables.

The variation of humidity and the dipping on each workday continue until 19 days have passed. The next drying period after the dip is then increased to about a day; on the twentieth day the test is shut down, and the specimens are removed from the test and weighed immediately with the rust intact. These weight gain data are used as a check and may be valuable later in generalizing why some steels corrode in the manner they do.

Specimen Cleaning:

The final criterion for evaluating the corrosion resistances of the various materials is the weight loss. To measure the weight loss accurately one must remove all of the corrosion product and none of the uncorroded base metal. This is done at present by first hammering the specimen to remove the loose outer rust and then cathodically descaling in an inhibited 5 per cent sulfuric acid solution(**1**).[3] The use of electrolytic descaling has been the main factor in the accuracy and precision of the test—the error associated with the process of removal of the corrosion product is normally of the order of one part per thousand parts corrosion loss.

Analysis of the Data:

The specimens are weighed again after descaling, and the losses are calculated in grains per sq in to yield a convenient quantity (one grain = $^1/_{7000}$ lb). The data are then analyzed statistically

[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE I.—ANALYSES OF STEELS TESTED.

	Carbon, per cent	Molybdenum per cent	Phosphorus, per cent	Sulfur, per cent	Silicon, per cent	Chromium, per cent	Copper, per cent	Nickel, per cent	Remarks
Steel A	0.08	0.32	0.012	0.025	...	0.02	0.075	0.04	Rimmed
B	0.06	0.34	0.010	0.028	0.012	0.04	0.08	0.04	Aluminum killed
C	0.13	Proprietary		...	...	...	...	...	SAE 950
D	0.16	0.73	0.11	...	0.21	...	0.22	0.24	GMR[b]
D'[a]	0.15	0.64	0.12	...	0.17	...	0.24	0.22	Atmospheric
E	0.18	0.67	0.036	...	0.19	...	0.23	0.26	GMR
E'	0.19	0.66	0.033	...	0.18	...	0.22	0.26	Atmospheric
F	0.15	0.12	0.012	0.015	0.04	...	0.02	4.98	GMR
F'	0.14	0.24	0.007	0.014	0.10	...	0.02	4.91	Atmospheric
G	0.14	0.47	0.012	...	0.09	...	0.01	0.05[c]	GMR
G'	0.18	0.62	0.011	...	0.18	...	0.01	0.05	Atmospheric
H	0.10	Proprietary		...	...	...	...	...	SAE 950

[a] Similar steel tested by International Nickel Co.
[b] Tested in the General Motors Accelerated Test.
[c] Less than 0.05 per cent.

by application of the Fisher t test (2). One of the most convenient methods for expressing the data is shown in Fig. 4, where corrosion loss is plotted against specimen number. Also shown are the means (lines through the points) and the numerical values of the means, $\bar{x}$, and standard deviations, σ, for the three steels. (The compositions of the steels are found in Table I.) This plot serves several purposes: (*a*) if the samples are numbered in the order of their place in the sheet, any variation of corrosion loss due to position on the sheet should be apparent; and (*b*) one can see immediately the precision of the data. Statistical calculations indicate that the differences shown here are not due to chance at least 99 times in 100; that is, the differences are due to inherent differences in the corrosion resistances of the steels.

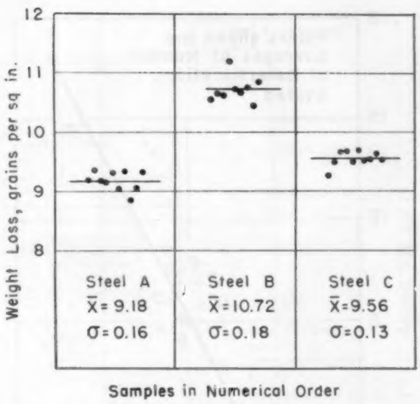

Fig. 4.—Samples in Numerical Order Graphical Presentation of Data of Test 8.

Results

The physical nature of the rust formed during testing is very interesting. As shown in Fig. 5, it is of a lamellar nature and is rather brittle; the rust was spalled off in the illustration merely by bending the specimen. The outer layer has been shown by X-ray analysis to be mainly either $Fe_2O_3 \cdot H_2O$ or $Fe_2O_3 \cdot nH_2O$, while the more adherent inner layer is mainly Fe_3O_4.

This lamellar nature can be associated with the nonprotective behavior of the rust. As each cycle is completed, a little more corrosion takes place; if the rust layer does not become protective, the additional corrosion occurring on each cycle will be about the same, and hence the rust will have a layered effect.

Linear Tendency:

If a nonprotective rust is formed, then the corrosion loss should be linear with the number of cycles. Figure 6 shows data accumulated during a single test on standard steels A and B. These steels are rather representative of materials from which automobile bodies are made (see Table I). The coefficient of linear correlation between weight loss and the number of cycles is approximately 1 for each steel: The loss is linear with the number of cycles. (As a guide to the amount of metal being removed, the typical specimen originally has 30 to 36 grains per sq in.)

The same trend is shown in Fig. 7; here all available data on steel A are plotted as averages of the number of determinations shown. The best fit line has been drawn. The testing represented here was conducted over a ten-month period during which the test was developed and while efforts were made to keep all tests alike, some operating variables were introduced from time to time. Despite these variables, the linear tendency is pronounced.

The linear behavior has been shown to exist over quite a few cycles. Weight loss data below ten cycles do not fit the straight line.

Rate curves are not developed for each steel being tested, but a count is made of the number of cycles. For purposes of comparison, the data of the various tests are reduced to a common number of cycles.

Effect of Elimination of Dip:

One test was run with the regular humidity cycle, but without dipping. The omission of the dip dropped the corrosion losses to about one tenth the losses with the dip.

Comparison with Salt Spray:

Test specimens of the standard steels were also exposed in the General Motors Research Laboratories salt-spray room for 20 days. The environment was essentially a modified ASTM test[2] utilizing a 5 per cent salt solution instead of the usual 20 per cent. The specimens were suspended both vertically, as is the practice in the present test, and at the 15-deg angle prescribed in the ASTM test.

The corrosion losses were similar with both suspensions, even though most of the corrosion had occurred on just the exposed surfaces of the specimens hung at the 15-deg angle. Corrosion of the specimens hung vertically was fairly uniform. The magnitude of the salt-spray corrosion losses in 20 days was only about 30 per cent that of the present test. The differences between the corrosion losses of the various steels were not significant at the 1 per cent level.

Comparison with Atmospheric Exposure:

For a comparison with atmospheric exposure tests, several experimental

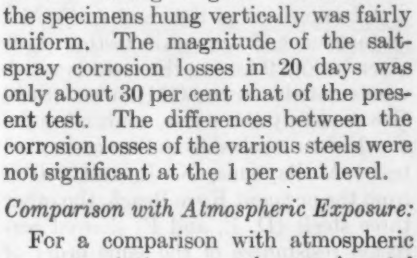

Fig. 6.—Number of Cycles Linear Behavior of Corrosion Loss with the Number of Cycles.

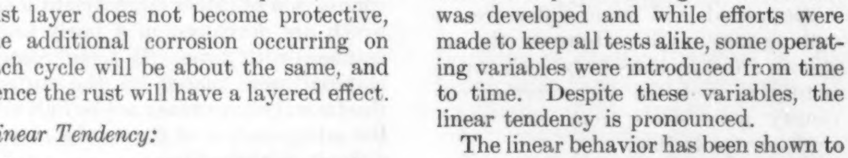

Fig. 5.—Corrosion Specimen with Rust Partially Removed (Natural Size).

steels made by the International Nickel Co. were exposed to the General Motors Research (GMR) cyclic humidity test. These steels were very similar to ones having histories of atmospheric exposure at Kure Beach, N. C. and Bayonne, N. J. The compositions of the pairs of steels are very similar and the heats were apparently made consecutively; therefore in this discussion the steel exposed to this test and its counterpart exposed to the atmosphere will be considered one and the same.

The results of exposing these steels to the cyclic humidity test are given in Fig. 8. The weight losses are plotted in grams to be consistent with other data to be shown later. As before, the averages are shown by a line through the points, and the means, $\bar{x}$, and standard deviations, σ, are listed on the graph itself. Two tests were run with an interval of five months between the tests. The ranking of steels E, F, and G is very similar in both tests; the test does indeed yield reproducible results. Clearly steel G has the poorest corrosion resistance, while apparently E is next; F and D are quite close, with D perhaps being a little better.

A comparison of the results of GMR and atmospheric exposure testing (**3**) is given in Fig. 9 for the three steels which were run twice in the GMR test. Steel G was clearly the worst, confirming the conclusions reached from the accelerated test. At Bayonne, N. J., and 800 ft from the ocean at Kure Beach, the other three steels (D, E, and F) showed corrosion resistances of the same order of magnitude, although steel F was the best in each location (superior to D, which is not shown on Fig. 9). At the 80-ft location, the differences between steels are magnified, especially at times longer than the 182 days plotted in Fig. 9, but the order of ranking is the same. The GMR test ranked the four steels in order of ascending corrosion loss as follows: D, F, E, G; atmospheric exposure at the three locations rated the steels F, D, E, G. Therefore the test

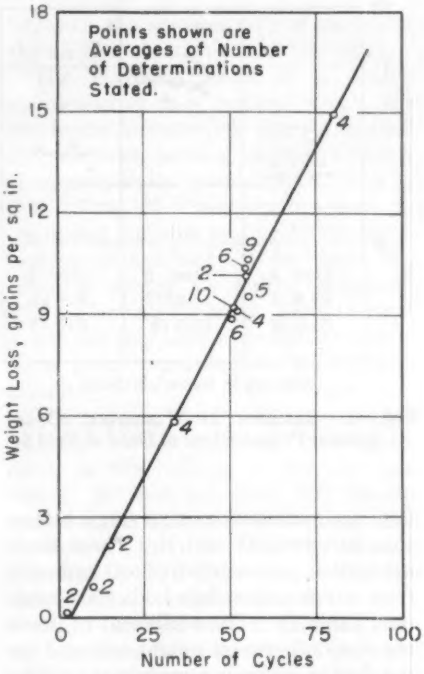

Fig. 7.—Number of Cycles Linear Behavior of Corrosion Loss with Number of Cycles—Steel A—Data of Seven Tests.

does not always rate steels in exactly the same order as atmospheric exposure when the steels exhibit the same order of magnitude of corrosion resistance in the atmosphere. This is to be expected because in outdoor exposure testing protective rusts form and are responsible for the ranking of the steels. In the accelerated test this protective tendency is suppressed, and minor differences in ranking may result. However, the accelerated test appears to be quite satisfactory as a device for screening obviously poor steels from ones which merit service testing.

Figure 9 shows that the present test is indeed accelerated. In 20 days as much corrosion occurs as in 3 yrs at Bayonne, N. J., or 42 months 800 ft from the ocean at Kure Beach, N. C.

The Small Spread Between Steel:

The small amount of spread between the steels in Fig. 8 is a consequence of the nonprotective nature of the corrosion product. Steel F shows its superiority in the atmosphere by forming a fairly protective rust. In this test the tendency is suppressed, and the corrosion loss is considerably higher, thus decreasing the spread between the best and worst steels. The small spread is characteristic of the testing of bare steels with alloy content below 5 per cent to date. The best steel tested with alloy content below 5 per cent, steel H, lost 7.16 and 7.45 grains per sq in. (averages) at the end of tests running 54 and 55 cycles, respectively, while the worst steel, steel B, lost 11.77 and 11.67 grains per sq in. (averages) at the end of 54 cycles in two different tests.

Differentiating between small differences in corrosion losses requires a carefully controlled test which has a high degree of precision. This test usually yields data precise enough to show statistically significant differences (at the 1 per cent level) when the differences are of the order of 0.5 grain per sq in. or so.

Limitations of the Test:

This test has the advantage of developing a nonprotective rust over a considerable length of exposure; however, there are certain limitations in its application. The test was developed for bare steel specimens and depends upon the attack of the surface. The criterion for evaluating the corrosion resistance is comparison of rather large weight losses which are developed in a fairly linear manner, with time. If some coating material were placed on the surface, this linear behavior may not be followed; the interpretation of the results may be difficult or misleading.

Conclusions

1. A rust having a lamellar nature is developed by this test; the amount of corrosion occurring in linear with the number of cycles over a considerable number of cycles.

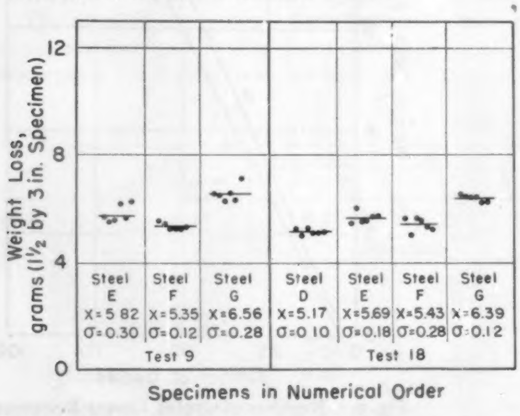

Fig. 8.—Specimens in Numerical Order Corrosion Data for INCO Steels—GMR 20 Day Tests.

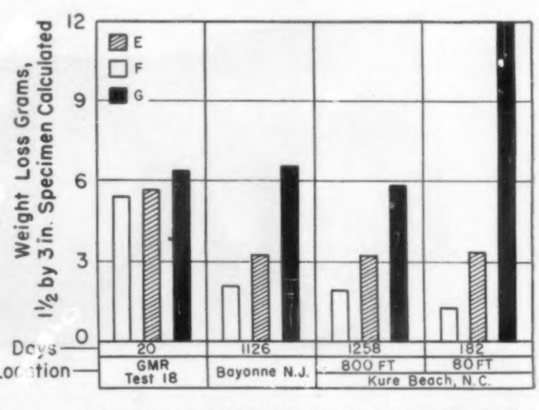

Fig. 9.—Comparison of GMR Test with Atmospheric Exposure Data.

2. The data obtained from this test are reproducible and have a high degree of precision.

3. Specimens exposed to this test are corroded about three times as much as specimens exposed to a modified ASTM (5 per cent) salt spray atmosphere for a period of 20 days.

4. Comparison of similar steels exposed to this test and the atmosphere at Kure Beach, N. C. and Bayonne, N. J. proves: (*a*) An accelerated test has been developed and, (*b*) This test will differentiate properly among steels showing considerable differences in corrosion losses under atmospheric exposure conditions.

Acknowledgments:

The authors wish to thank the Corrosion Engineering Section of the International Nickel Co. for some of the experimental steels used here and permission to publish some of their results. In addition, the authors are grateful to Bethlehem Steel Co, Great Lakes Steel Corp., Inland Steel Co., Republic Steel Corp., Union Carbide and Chemical Corp., United States Steel Co., Vanadium Corp. of America, and Youngstown Sheet and Tube Co. for their assistance in supplying materials. They also acknowledge the assistance of E. R. Cprek in carrying out some phases of the testing procedure and making the illustrations.

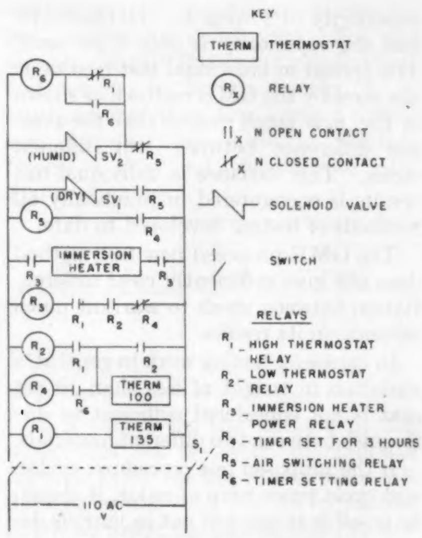

Fig. 10.—Schematic of Cycling Control Mechanism.

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(1) B. B. Knapp, "Preparation and Cleaning of Specimens—The Corrosion Handbook," (edited by H. H. Uhlig), p. 1077. John Wiley and Sons, Inc., New York, N. Y. (1948).

(2) J. F. Kenney, "Mathematics of Statistics," Part 2, p. 140. D. Van Nostrand Co., Inc., New York, N. Y. (1939).

(3) M. Rebbington, The International Nickel Co., Inc., 67 Wall Street, New York, N. Y. Private communication.

APPENDIX

Electrical Circuit for Controlling the Test

The electrical control circuit (Fig. 10) is rather complicated at first sight. However, the relays can be divided into two groups to simplify the explanation as follows: humidifying (R_1, R_2, R_3) and drying (R_4, R_5, R_6).

Two thermostats located on the humidifying tower limit the cycling between the desired temperatures. Their action is transmitted to R_1 and R_2. If R_4 be open, then R_1 and R_2 will control R_3, applying power to the immersion heater when both are closed. This is the basis of the humidity cycle.

The remaining relays permit the drying period to be inserted into the cycle. If R_4 is open, R_5 is open; R_6 will close when R_1 opens (at 135 F), and will be held in until R_5 is closed.

When the low-temperature thermostat closes again, both R_2 and R_4 will close. R_3 will now be prevented from closing by R_4; no power is applied to the immersion heater while the timer is operating. R_4 closes R_5, which switches the air from the humidifying tower to the drying train by means of the two solenoid valves (see Fig. 3). R_5 also opens R_6: R_4 cannot be re-energized at the end of the 3-hr period; instead R_3 closes and the heating period is begun.

Thus the schematic control circuit (Fig. 10) will do the proper cycling. Actually several additional relays are added to the minimum number shown here.

DISCUSSION

Mr. F. L. LaQue[1].—The critical feature of the test described in this paper is that the conditions of exposure are such that steels are unable to form protective rust films that would cause rates of corrosion to diminish with time. This point is emphasized because:

1. Results will be applicable only to services where protective rusts do not, or cannot, form.

2. Differences in atmospheric corrosion resistance of steels that depend on differences in the protective qualities of their rusts (as they usually do) are not likely to be predicted by this test.

The authors' primary concern is with corrosion of steels in automotive service. If such corrosion proceeds without any restraining effects of protective rusts, even on alloy steels, then the relative merits of different steels may be indicated properly by this accelerated test. But, until the corrosion *versus* time relationships of practical service for different steels have been ascertained, the significance of the results of this test must remain questionable.

Numerous investigations have established that for the rust that forms on one steel to become more protective than the rust that forms on another there must be changes in the chemical and physical natures of the rusts that occur in the atmosphere only when there are opportunities for the rust films to become dry—at least occasionally—and for long enough to enable the desired reactions to occur. It has been shown also that, as compared with effects on the inherent reactivity of the steels, the influences of compositional changes on the protective qualities of rusts are much greater. This means that the maximum opportunity to improve the life of steel exposed to atmospheric corrosion by changing the composition of the steel will exist where the conditions of use will permit the necessary occasional drying of the rust films. Therefore, the achievement of longer life of steel parts of automobiles will be aided greatly by attention to details of design and construction with reference to drainage and ventilation that will give steel surfaces a maximum opportunity to become dry and thereby develop protective rusts. It seems safe to predict that to reach the desired goal will require attention to such design features, as well as concern with the compositions of the steels, and that studies along both lines should proceed in parallel. It also follows that if this course is taken, then the present test which does not permit the development of protective rusts will not be applicable to the choice of steel.

On the other hand, if it can be decided that protective rusts do not form on automobile parts and that nothing can be done to improve this situation, then the following will apply:

1. Results of conventional atmospheric corrosion tests which ordinarily are determined by the formation of more or less protective rusts may not be applied to an estimation of the relative merits of different steels in resisting the corrosion encountered in automobiles.

2. The chance of finding any steel of low alloy content that will be much

[1] In charge, Corrosion Engineering Section, Development and Research Division, The International Nickel Co., Inc., New York 5, N. Y.

more durable than ordinary steel will be very slight—as illustrated, for example, by the results of the accelerated tests in this paper in which a steel F which was about 10 times more durable than another steel G when exposed in a marine atmosphere was shown to be only about one fifth more durable under the conditions of the accelerated test. Along these same lines, it should be emphasized also that for the reasons stated this accelerated test cannot be expected to make proper distinctions among steels as to their relative abilities to resist atmospheric corrosion in any service where occasional drying will permit protective rusts to develop on steels of proper composition.

Finally, one might question whether some of the differences among the steels shown by this accelerated test are really significant. The definition of a significant difference is not clear from the discussion in the paper. With reference to Fig. 9, the authors stated that the corrosion resistances of three steels exposed 800 ft from the ocean at Kure Beach and at Bayonne, N. J., which showed about a 300 per cent variation between the best and the worst were similar. Nevertheless, they attached significance to a variation of about 20 per cent among these same steels in the laboratory test.

With further reference to the data in Fig. 9, it might reasonably be expected that a test which reduces the spread between two steels from 1000 per cent under natural conditions of exposure to about 20 per cent in the accelerated test might have the effect of crowding a great many steels into a narrow band of performance in which differences might be expected to be slight and even rankings in order of probable merit quite questionable. One might also question the practical value of being able to measure precisely small differences in corrodibility of steels when one is seeking a major improvement in performance in service.

Chairman Sam Tour.[2]—The General Motors Research corrosion test as described by Opinsky, Thomson, and Boegehold may be much more rapid or severe than a salt spray test, but such activity is not an adequate criterion as to the value of the test.

If the test is to be used for rating the relative resistance of different steels to atmospheric corrosion, it should do better than this test had done as indicated in Fig. 9 of the paper. The minimum ratio for comparing steel F to steel E in any of the three atmospheric locations would indicate a 35 per cent superiority of F over E. In the GMR test the superiority is only 4 per cent. The spread in individual test results on one steel by the GMR method, as shown in Fig. 8, is much greater than the average difference between two different steels. This variance in individual test results is encountered in practically all methods of testing developed to date.

The GMR proposed new test method does not give sufficiently clear differentiation between steels to warrant much reliance on its results.

In corrosion testing work in general, a variation in weight of less than 10 per cent is not considered sufficient to distinguish between two different materials.

If the proposed test procedure, cycles, and cycle times were of value, it should be possible to carry it out in various designs of equipment besides that described by the authors. For example, it may not be necessary to flood and drain a test chamber in order to give the specimens a dip treatment.

Messrs. A. J. Opinsky, R. F. Thomson, and A. L. Boegehold (*authors' closure*).—The authors appreciate Mr. LaQue's remarks. In view of his long experience in the field of corrosion testing, we feel his comments are very useful in appraising the applicability to be expected from a test such as the one described here. We feel whatever difference of opinion exists is the result of difference in objective in corrosion testing. Where one is interested in predicting service life, we agree that the best test is service testing. Where one is interested in appraising the comparative merits of a large number of materials, service testing is lengthy and expensive. We believe great value can accrue from the use of an accelerated test of adequate precision and applicability.

We believe it reasonable to assume that there are certain kinds of service not only in connection with automobiles but also in other fields that will expose steel to conditions which prevent the formation of a protective type of rust on existing low-carbon low-alloy sheet steels. Under conditions of this kind, an atmospheric corrosion test such as conducted at Kure Beach or anywhere else will give a wrong indication of what to expect from a steel. We know that automobiles in the past have subjected steel to just such conditions, and it has been true that low-alloy steels that showed substantially better corrosion resistance than ordinary body steel when exposed at Kure Beach have shown no better corrosion resistance than ordinary body steel in certain locations on the automobile.

The test we have described has been developed to compare steels when used for service under conditions of this kind, and we believe it gives a precise measure of the corrosion resistance of existing steels when not shielded from the corroding agency by a protective rust formation.

Mr. LaQue points out "the results will be applicable only to services where protective rusts do not, or cannot, form." This statement is predicated on the pessimistic assumption that all steels which might be developed in the future will (1) show the same kind of nonprotective rust under the conditions set up by this test, and (2) the slope of the corrosion loss curve under the conditions of this test will not be significantly different for different steels. The authors share neither the pessimism nor the basic assumptions.

We do not concede that there is no hope for finding a low-alloy steel which even under the accelerated conditions of this test will not produce a protective rust appreciably better than steels of the type reported in this paper. If a steel could be developed which will form a protective scale under the conditions of this test, we believe this steel will have greatly improved corrosion resistance for many outdoor exposure applications.

We believe further there is a possibility that even though the rust formed may be nonprotective, the inherent corrosion resistance of the steel may be improved. Figure 6 shows that, while the weight loss of both steels A and B are linear with number of cycles, the slopes of the curves are different and result in significant differences in weight loss at the end of 80 cycles.

Stainless steel of the 18–8 type when exposed to this test shows very little weight loss.

The authors do not understand Mr. LaQue's statement, "The chance of finding any steel of low alloy content that will be much more durable than ordinary steel will be very slight—as illustrated, for example, by the results of the accelerated tests in this paper in which a steel F which was about 10 times more durable than another steel G when exposed in a marine atmosphere was shown to be only about one fifth more durable under the conditions of the accelerated test." Figure 8 definitely shows F to be superior to G and that is what outdoor exposure tests shown in Fig. 9 show. The authors admit Fig. 8 does not show the absolute differences to be expected on outdoor exposure but they have never claimed this for the test. We do not believe this is serious because neither do the data at 800 ft at Kure Beach show the absolute differences to be expected at the 80-ft location.

With regard to Mr. LaQue's question regarding significant differences when he

[2] Chairman of the Board, Sam Tour and Co., Inc., New York, N. Y.

refers to data at the 800-ft Kure Beach and Bayonne, N. J., locations, we believe there is misunderstanding through possibly an unfortunate choice of words by the authors. The intent was to say that the tests at Bayonne and Kure Beach showed the same order of magnitude of difference between the steels. For example, steel G is about twice as poor as steel E at both Bayonne and 800 ft at Kure Beach, and about three times as poor as steel F.

The practical value of being able to measure precisely small differences in corrodibility in an accelerated test is that it will improve one's "batting average" when finally subjecting parts to service performance or even outdoor exposure testing in trying to develop more corrosion resisting steels.

With regard to Mr. Tour's comments, we wish to point out the data he cites do not support his conclusions. For example, he says, "The spread in individual test results, as shown in Fig. 8, is much greater than the average difference between two different steels." Figure 8 does not substantiate Mr. Tour's statement.

It is stated by the authors in the paper that the test will "differentiate between steels having considerable differences in corrosion loss under atmospheric corrosion conditions, but does not always rate the steels in exactly the same order as atmospheric exposure when the steels exhibit the same order of magnitude of corrosion resistance in the atmosphere." When one compares steels F and G, the spread in individual samples is less than the spread of the mean values as shown in the following table:

	Weight Loss, g					
	Steel	High	Low	Spread	Mean	Spread of Mean
Test 9...........	F	5.56	5.24	0.32	5.35	
	G	7.13	6.25	0.88	6.56	1.21
Test 18...........	F	5.72	5.03	0.69	5.43	
	G	6.58	6.22	0.36	6.39	0.96

We believe these steels have considerable differences in corrosion behavior in our test. The difference between steels E and F is obviously considerably less as shown in both the GMR and outdoor exposure tests.

Laboratory Equipment for Buffing Rubber Specimens*

By S. A. Eller,[1] W. K. Gondek,[1] and C. K. Chatten[1]

In an earlier article,[2] the authors reported on the development of a machine for use in buffing strip samples of rubber materials. The original machine has since been modified and improved so that rough strips of elastomeric materials having maximum dimensions of 24 by $1\frac{1}{4}$ by $\frac{1}{2}$ in. can be buffed to a predetermined thickness with a tolerance of ± 0.001 in. over the entire buffed surface. In addition, attachments have been made for buffing ASTM compression set specimens to a diameter of 1.129 ± 0.002 in. The diamond dressing device has also been improved to true up damaged or dulled emery wheels more accurately and quickly.

The authors believe that, with slight modifications, the machine may also be adapted for use in preparing test specimens from other organic materials, such as leather, nonrigid plastics, etc.

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* The opinions or assertions contained in this paper are the private ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

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[2] C. K. Chatten, S. A. Eller, and W. K. Gondek, "A Machine for Use in Buffing Strip Samples of Rubber Materials," *Rubber Age*, September, 1948.

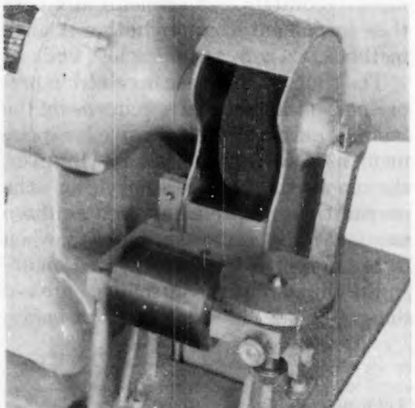

Fig. 1.—Buffing Machine for Preparing Strip Specimens.

Apparatus for Buffing Strip Materials

The buffing machine consists essentially of a motor-driven emery wheel and a hollow brass roller which serve as the abradant and the backing, respectively, for the elastomeric strip being buffed. The brass roller rotates freely in the U-shaped frame which can pivot between the two positions shown in Figs. 1 and 2 when raised or lowered manually by the handle shown to the left of the roller. As shown in the photographs, a thickness adjusting screw is in threaded engagement with the U-shaped frame to the right of the roller. When the frame is pivoted to the position shown in Fig. 2, the spherical base on the adjusting screw contacts an upright stop, thereby limiting the clearance space between the emery wheel and the brass roller. This clearance space determines the thickness to which the elastomeric strip will be buffed. The calibration of the dial on the thickness adjusting screw is such that each division corresponds to 0.001 in. of clearance space between the brass roller and the emery wheel.

Preparation of Strip Specimens

The thickness adjusting screw is set so that the clearance between the roller and the emery wheel is from 0.002 to 0.004 in. less than the thickness of the

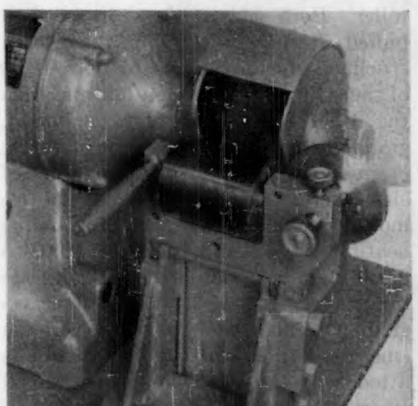

Fig. 2.—Another View of Buffing Machine.

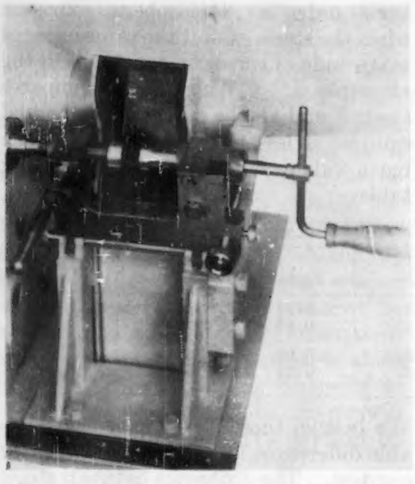

Fig. 3.—Jig Attachment Used in Buffing Compression Set Specimens.

strip to be buffed. The U-shaped frame is then pivoted manually to a position between those shown in Figs. 1 and 2. One end of the rubber strip is held by hand, allowing the remainder of the strip to fall between the enlarged clearance space with the side of the strip to be buffed facing the emery wheel. The U-shaped frame is pivoted upward until the base of the adjusting screw contacts the stop, and then the rubber strip is lifted slowly, the excess thickness of rubber material being abraded away until the strip is clear of the emery wheel. This operation is repeated on both sides and from both ends of the strip until it has been abraded to the desired thickness. The machine can be used in buffing strips having maximum dimensions of 24 by $1\frac{1}{4}$ by $\frac{1}{2}$ in. to a desired thickness with a tolerance of ± 0.001 in. over the entire buffed surface. When one face of the strip is smooth and the other one is rough, the rough face is buffed first, the smooth face being in contact with the brass roller. Both sides of the strip are then buffed alternately to obtain the desired specimen thickness. When both faces of the strip are rough, first one and then the other face of the strip is buffed, gradually smoothing the specimen to the desired thickness. The amount of elastomeric material that can be removed per pass without causing undue heating of the strip varies from 0.002 to 0.030 in. depending on the type of elastomer, per cent and type of filler ingredients, and the roughness of the emery wheel. Each buffing machine is fitted with a rough and fine-grained emery wheel, the rough wheel for abrading large amounts of material per pass. However, all final buffing operations are performed with the fine-grained emery wheel, removing from 0.002 to 0.003 in. of material per pass.

Preparation of Compression Set Specimens

For making compression set specimens, the apparatus shown in Fig. 3 is attached to the machine support in lieu of the similarly constructed U-shaped frame and brass roller assembly shown in Figs. 1 and 2. This device consists essentially of a U-shaped frame having two opposing cylindrical presser feet designed to hold and rotate a compression set specimen while it is being abraded by the emery wheel. The left presser foot, used to tighten the specimen in position, is designed so that it can rotate independent of its mounting. The right presser foot is secured to the crank and can be rotated manually by it, thereby causing the specimen to rotate. Both presser feet have pieces of fine-grained sandpaper cemented to their faces so that the specimen is held firmly.

In order to prepare a standard compression set specimen, a disk of elastomeric material about $\frac{1}{2}$ in. thick and $1\frac{1}{8}$ in. in diameter is centered and lightly tightened between the presser feet. The crank is then rotated manually while the handle on the U-shaped frame is lifted slowly, thereby feeding the specimen into the rotating emery wheel. This operation is continued until the thickness-adjusting screw contacts the stop. The specimen must be rotated continually during the buffing operation in order to avoid flat spots on the periphery. The final buffing operation is made with very light contact pressure between the presser feet and the specimen in order to avoid concavity of the side walls. The diameter of the specimen can be checked using a micrometer or other suitable measuring device as the buffing operation progresses.

Diamond Dressing Device

If an emery wheel is replaced or when the abrading surface of the wheel becomes grooved, chipped, eccentric, or clogged with adhering particles, it is necessary to dress or true up the wheel. In order for the buffing machines to function properly, the dressing operation must result in an abrading surface on the wheel that is concentric with the drive shaft, free from adhering particles, and parallel to the surface of the brass roller. To accomplish this the U-shaped frame is pivoted to the position shown in Fig. 1 and the diamond dressing device is bolted to the frame as shown in Fig. 4. The dressing device consists essentially of a one-carat industrial diamond mounted in a holder so that the diamond generates on the emery wheel a surface which is concentric with the drive shaft and parallel to the brass

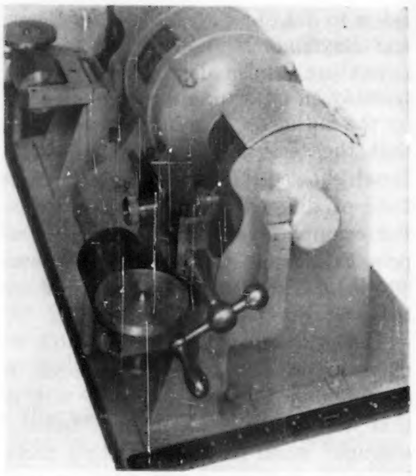

Fig. 4.—Diamond Dressing Device for Emery Wheel.

roller. The dressing device can be turned either from the left- or the right-hand side, to avoid interference with the motor. There are three buffing machines at the Material Laboratory, each equipped with a rough and a fine emery wheel. The diamond dressing device and the U-shaped frames were designed and constructed so that one dressing device fits interchangeably on all 6 frames (3 rough and 3 fine emery wheels).

Conclusions

It is comparatively easy to train unskilled personnel in the use of the above-described buffing equipment. In addition, it is believed that strips of elastomeric material suitable for use in cutting tension specimens can be prepared from such products as hose, gasket materials, battery compartment linings, shaft coverings, and expansion joints more accurately and economically with this equipment than by other known methods.

The time and expense involved in preparing compression set specimens by the buffing procedure are excessive for specimens used for routine tests. However, the method is satisfactory for the preparation of specimens such as those required for stress relaxation tests, when the load values, in psi, are based on accurate measurements of the face area of the specimen.

Acknowledgment:

The authors wish to thank A. Charters of the Material Laboratory Machine Shop for his valuable suggestions in making and assembling the Material Laboratory Buffing Apparatus.

The Serviceability of Transformer Oil

By Frank M. Clark[1]

EDITOR'S NOTE.—This paper on the Serviceability of Transformer Oil was prepared for presentation at the Conference Internationale Des Grands Reseaux Electriques (C.I.G.R.E.) in Paris, June, 1952. By permission of C.I.G.R.E. we are making this paper available to readers of the ASTM BULLETIN. It is felt that it will be a timely adjunct to the Symposium on Insulating Oils—Fourth Series (*STP No. 135*) which recently became available.

THE proper selection of a mineral oil for transformer use presents many problems, not the least of which is an evaluation of its sludging characteristic. To predict the expected sludging tendency of an oil during years of transformer operation is a technical problem which has been widely studied in many of the world's most proficient laboratories. Despite the importance of the problem and the wide variety of testing procedures which have been suggested, there has been no general acceptance of a standardized testing method for the gaging of the expected behavior of the new transformer oil during commercial use.

The American Society for Testing Materials has tentatively established two distinct testing procedures[2] for evaluating the sludging propensity of new transformer oils. More recently, the characteristics of American mineral transformer type oils, some of good and some of poor sludging quality, have been studied during years of transformer operation. The results of these studies have been recently summarized in presentations before the American Society for Testing Materials.[3] From these studies it is hoped that an acceptable laboratory testing method can be established for predicting the continued serviceability of an oil at any stage during its transformer use.

However, despite the greatest care which can be exercised in the selection of an oil for transformer use, the operator of an oil-filled transformer always assumes that he will eventually be confronted with an oil sludging problem. This arises from the oxidizable nature of the oil itself. One American company which operates large numbers of transformers estimates that with a transformer design which permits the free breathing of a normal atmosphere of air, the "life" of the transformer oil is approximately 10 to 15 years. This short life of the oil has been responsible for many engineering and chemical studies having the object of reducing or eliminating the possibility of oxidation. The oil in the conservator type of transformer, the design of which was introduced about 1924, is so protected from oxidation that its expected life has been more than doubled as compared to the oil in the older, free breathing type of transformer. In the gas-sealed transformer brought out in 1933, the possibility of oil oxidation is still further reduced by the displacement of air with nitrogen or other inert gas. More recently, the use of oxidation inhibitors has been promoted as a chemical means of prolonging the usefulness of oil in transformer service. The complete effectiveness of the gas seal construction and the use of oxidation inhibitors in prolonging the life of a transformer oil has not yet been evaluated under practical conditions.

The expression "oil life" has in itself undergone a change in its meaning and definition as attempts to increase it have progressed. It is obvious that the length of time that a given oil can be used depends on the conditions of its use—the design of the transformer, the catalytic effect of the materials of transformer construction, the temperature of the oil, the degree of transformer loading and its cycling, the availability of oxygen, and other factors. But beyond this, there have been changes in the operating maintenance and objectives that seriously affect the conception of "oil life." Many operators of transformers in the past and possibly even now consider the "oil life" as that period of transformer operation which elapses up to the time when sufficient sludge formation has occurred in the oil to affect adversely the thermal properties and, therefore, the electrical loading of the transformer. In some types of transformers, this may mean an accumulation of sludge to as much as 1 per cent by weight of the oil without disastrous effect. Such extremes of sludging, however, are not now generally considered to represent good operating practice, and most generally the objective of present practice is to limit more severely the permissible oxidation of the oil. This is most generally done by a careful review of the color, acidity, and (more recently) the interfacial tension value of the oil. The permissible maximum values for these oil characteristics are based on operating experience, but with typical American oils the development of a color greater than $3\frac{1}{2}$ (ASTM) or an acidity greater than 0.6 mg of KOH per gram is frequently not permitted without special study of the oil. Oils having an interfacial tension value less than 20 dynes per centimeter are also frequently considered to be in the category where rapid sludging is to be expected.

It has been the practice of the Detroit Edison Co. to examine carefully those transformers which are removed from service for reasons in addition to those arising from oil oxidation. In this examination, the transformer is untanked and a thorough inspection of the tank and core is made together with a complete analysis of the oil in each instance.[4] Twenty-three per cent of all the transformers examined have been found to contain sludge on the cooler portions of the transformers in an amount estimated to be $\frac{1}{16}$ in. or more in thickness. In practically all of these transformers the oil acidity was 0.6 or more mg of KOH per gram of oil and the oil color was $3\frac{1}{2}$ or darker. Furthermore, the cooling capacity of the transformer has been found to be decreased when the accumulated sludge deposit is greater than $\frac{1}{16}$ in. To obtain reliable information of this type, however, the transformer must be thoroughly examined. Mere lowering of the oil level for an examination of the terminal boards or the upper section of the core has not been sufficient to establish whether sludge is present. Unless heavy sludge deposits are present in the cooler portions of the transformer, there is little or no evidence of sludge on the upper structure. On the basis of such observations, it has been established that good transformer practice would be to remove oil from service when the

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[1] General Electric Co., Schenectady, N. Y.

[2] Tentative Methods of Test for Sludge Formation in Mineral Transformer Oil, (D 670 – 42 T), 1949 Book of Standards, Part 5, p. 973; Part 6, p. 214.

[3] Symposium on Insulating Oils—Fourth Series, Am. Soc. Testing Mats. (1952). (Issued as *STP No. 135*.)

[4] Private communication from T. A. McConnell, Detroit Edison Co.

neutralization number exceeds 0.6 mg KOH per gram of oil or when its color exceeds a value of $3\frac{1}{2}$. Further study has shown that this condition of oil oxidation corresponds to an interfacial tension value of about 16 dynes per centimeter.

At the Commonwealth Edison Co. (Chicago) the problem of oil sludging has been met by a careful control and limitation of oil oxidation in transformer service.[5] The condition of an oil in transformer use is gaged by a number of test criteria including oil acidity and dielectric strength but the presence or absence of sludge precipitation *per se* is considered of major importance. By the elimination of badly sludged oil and the prompt removal of oil which is definitely noted to be sludging, the tendency toward the increased electrical loading of the transformers should not seriously affect the control of the sludge problem. As was general in the electrical field at the time, it was formerly the practice of Commonwealth Edison to permit the use of an oil until the transformer had reached the stage where a major rehabilitation or cleaning job was required. To do a completely satisfactory cleaning job was frequently impossible. Present practice, based on the inspection of thousands of oil samples and all types of transformers, is to consider any oil which has reached the sludging stage to be bad for the transformer in the long-range aspect. In accordance with this practice, oil containing more than 0.015 per cent of sludge by weight is removed from the transformer. This low tolerance limit for permissible sludge in samples of oil drawn from an operating transformer has been established in order to protect against the greater accumulation of sludge on the core and windings of the transformer.

The Narragansett Electric Co.[6] has made a detailed study of transformer oil and its deterioration over a period of 25 years. The accumulated experience of this company has indicated that the presence of any sludge causes accelerated deterioration of the oil and the insulation of the transformer and promotes dielectric troubles related to the presence of moisture. Transformer failures attributable to controllable conditions have been substantially eliminated since the establishment of a rigid control of oil condition in service. In accordance with this control, oil is removed from transformer service when its interfacial tension value drops to 20 dynes per centimeter, a value which eliminates the possibility of any substantial amount of sludge formation in the oil.

The question then of how much sludge is permissible in an oil-filled transformer is subject to innumerable interpretations in accordance with the ideas and desires of the operator. Experience appears to indicate that with uninhibited transformer oil, typical of American transformer practice, the continued use of an oil beyond that degree of oxidation necessary to produce sludge precipitation may promote a further increase in the rate of deterioration of the oil and the insulation of the transformer and may lead to an exaggeration of dielectric troubles. Because of this, American transformer practice is placing emphasis on the reduction or complete elimination of oil oxidation. In some instances, this objective is being sought by mechanical means, in others by the use of oxidation inhibitors. A more extensive practical experience with inert-gas-sealed transformers and oxidation inhibitors is necessary before a well-founded maintenance procedure for their practical use can be established.

[5] Private communication from L. B. Schofield, Commonwealth Edison Co.

[6] Private communication from E. F. Walsh, Narragansett Electric Co.

Apparatus for Tension Testing at Subatmospheric Temperatures

By E. T. Wessel and R. D. Olleman[1]

SYNOPSIS

An apparatus for producing tension testing temperatures from room temperature to −195.6 C is described. Nitrogen vapor is utilized both as the refrigerant and as the testing medium. Predetermined test temperatures are readily obtained and accurately stabilized with an automatic control and recording system. The apparatus is simple and economical to operate and may be adapted to other types of tests. The possibility of testing at even lower temperatures is discussed briefly.

During the past few years, an increasing need for information on the subzero properties of metals has developed. Data from tests at low temperatures are necessary in solving service application problems, in the determination of transition temperatures, and in fundamental studies of the behavior of metals at low temperatures. Coupled with the need for these data is the problem of developing apparatus with which these subzero tests can be accurately performed. Although this report will be confined to a discussion of apparatus developed specifically for tension testing, the equipment can be adapted to other forms of mechanical testing such as torsion, bending, compression, and hardness.

General Requirements for Testing Apparatus

In order to be most useful for low-temperature work, testing apparatus should meet the following general requirements:

1. The temperature range in which tests can be performed should be as broad as possible.

2. The equipment should be capable of reaching predetermined temperatures accurately, and it should be able to maintain these temperatures during testing.

3. The test temperatures should be reached and maintained with a minimum of manipulation, inconvenience, time expenditure, and cost.

4. The test procedure should not introduce any unwanted variables in addition to those already present in standard tension tests.

An examination of the literature shows that existing methods and equipment fail to meet one or more of these requirements. In most of these methods the specimen is surrounded with a liquid bath which is cooled by direct addition of refrigerant to the bath or by passing the refrigerant through a coil immersed in the bath. All applicable liquids have a limited useful temperature range as defined by their boiling and freezing points. Freon 12 is commonly used because of its relatively wide temperature range, −27.8 to −160 C, and its inert, nontoxic characteristics. However, this temperature range is still undesirably limited. Temperatures above −27.8 C can be achieved by using a

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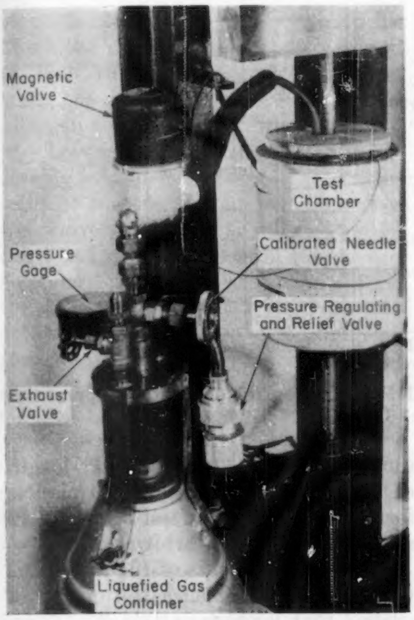

Fig. 1.—Apparatus for Maintaining Constant Subatmospheric Temperatures.

bath of some commercial solvent cooled by direct addition of dry ice. This method is widely used to obtain temperatures down to that of dry ice, −78 C. There is no liquid readily available to cover the range of temperatures from −160 C on down. Tests have been made in liquid nitrogen at its boiling point, −195.6 C, but unless a pressurized system is used this testing medium is practically confined to one temperature. Attempts have been made to test in liquid helium, but these have not been too successful because of the very small heat of vaporization of the liquid, 6 cal per g. Eldin (1)[2] has reported a method of low-temperature tension testing in which the whole tension testing machine is lowered directly into a helium cryostat. This equipment permits testing at temperatures as low as 12 K (−261 C); however, the cost of such apparatus would prohibit its use in many instances.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

In addition to leaving gaps in the temperature range, liquid testing media have other undesirable traits. Most of the liquids used, with the exception of the liquefied inert gases, are toxic and inflammable. Several have relatively low boiling points which necessitates storing them under refrigeration and precooling the apparatus in which they are to be used. Many of the liquid media and refrigerants required careful handling, as is discussed in a paper by Shevandin (2) concerning precautions to be taken in tests at low temperatures.

Accurate control at predetermined temperatures by the addition of dry ice to the bath or by passing liquid refrigerant through a cooling coil is difficult, since the bath temperature will tend to drift and accurate metering of required small additions of coolant to maintain temperature equilibrium will be necessary. Some degree of control can be attained when using a liquid refrigerant, such as liquid nitrogen, in a cooling coil by maintaining a fixed flow of coolant once a heat balance has been established. This procedure, however, involves considerable manipulation and time to establish an equilibrium temperature and is influenced by atmospheric variations.

The last disadvantage to be discussed is the effect of liquid testing media on the tensile properties of materials. It is entirely possible that the various liquid media now being used for low-temperature testing do have a considerable effect on mechanical properties. Benedicks (3) has shown, using hardened tool steel bend specimens 1.0 × 10.0 mm in cross-section, that strength can be affected as follows:

Liquid Medium	Increase (+) or Decrease (−) of Strength as Compared to Tests in Air, per cent
Water	−22
Ethyl alcohol	−13
Octyl alcohol	− 6
1.0 per cent NaOH solution	+15
Petroleum	+27
Benzine	+18
Hexane	+17
Certain rust protective mixtures	(up to +30)

A preliminary study by the authors has indicated similar results using tension specimens 0.2 in. in diameter by 1.0 in. gage length of a hardened, nondeforming tool steel. Benedicks has recently reported (4) that the wetting effect is primarily dependent on the surface tension of the wetting liquid and that the effect diminishes with diminishing hardness of the solid being tested.

Since there appear to be significant effects of liquid testing media on tensile strength, the use of liquid baths for low-temperature testing produces another variable to be considered in the interpretation of tension data. The apparatus described in this paper utilizes nitrogen vapor as the testing medium and also fulfills the other low temperature testing requirements.

Description of Apparatus

A photograph of the low-temperature apparatus with the test chamber mounted in the tension machine with which it is used is shown in Fig. 1. The schematic diagram given in Fig. 2 shows more clearly the essential components of the apparatus. These components may be divided into three functional groupings: the refrigerant storage and supply system, the refrigerant flow-regulating system, and the testing chamber.

The refrigerant storage and supply system is shown in Figs. 1 and 2. It consists of a standard 25- liter Dewar

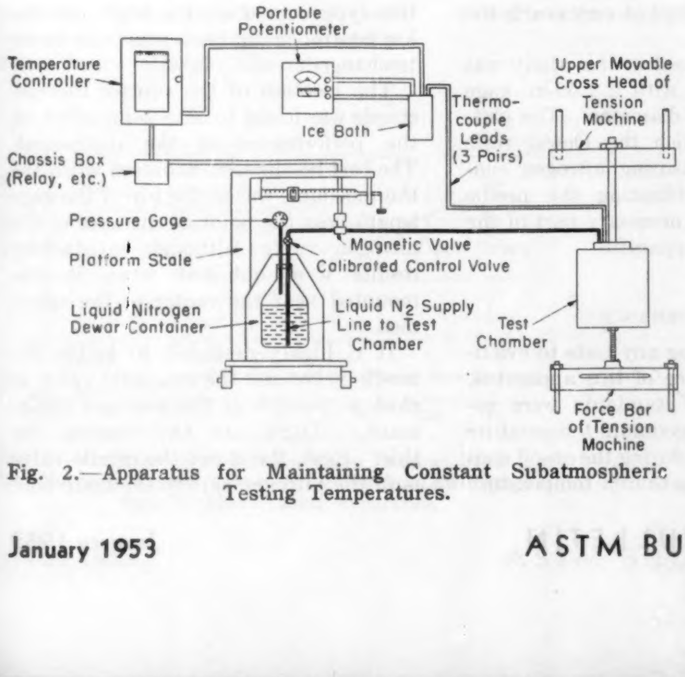

Fig. 2.—Apparatus for Maintaining Constant Subatmospheric Testing Temperatures.

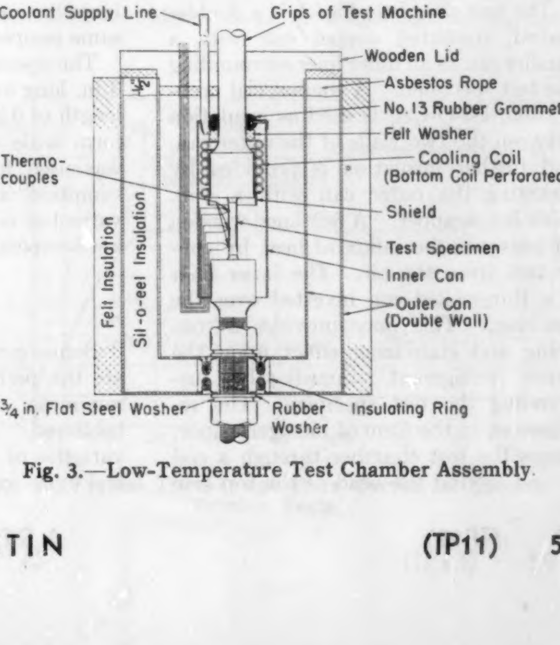

Fig. 3.—Low-Temperature Test Chamber Assembly.

flask equipped with a special head assembly (**5**). The essential components of the head assembly are a pressure gage, a pressure relief valve, an exhaust valve, and a $\frac{1}{4}$-in., slow-opening, packless needle valve with indicator wheel. The refrigerant, liquid nitrogen, is stored in the closed Dewar which traps the vapor evolved and builds up a pressure on the surface of the liquid. This pressure is indicated by the pressure gage and may be adjusted by means of the pressure relief valve. The pressure relief valve serves both to protect the Dewar from excessive pressure and to maintain constant supply pressure on the surface of the liquid nitrogen. This pressure forces the liquid up through the supply tube, which extends to the bottom of the Dewar, and the flow may be regulated by means of the needle valve installed in the supply line. The exhaust valve is used for reducing the Dewar pressure rapidly when desired and for filling the Dewar.

The flow-regulating system consists of the previously described needle valve, a small, packless magnetic valve, a 0-10 mv, continuously recording, self-balancing, potentiometer-type temperature controller, and a control thermocouple installed on the specimen in the test chamber. Two additional thermocouples are also installed on the specimen and connected to a portable potentiometer for purposes of checking temperature distribution. When more refrigerant is needed in the test chamber, as indicated by the control thermocouple, the controller energizes and opens the magnetic valve. This allows the nitrogen to flow at a rate determined by the setting of the needle valve. When additional refrigerant is not needed, the control thermocouple signals the controller which de-energizes and closes the magnetic valve and shuts off all flow of nitrogen. Copper-constantan thermocouple wire calibrated down to the temperature of liquid nitrogen is readily available.

The test chamber, Fig. 3, is a double-walled, insulated copper can with a smaller can as an inner liner surrounding the test specimen. A commercial preparation, Sil-O-Cel, is used as insulation between the two walls of the outer can, and further insulation is provided by jacketing the outer can with a $\frac{3}{4}$-in. thick felt wrapper. A felt-lined wooden lid prevents the influx of heat by convection from the air. The inner liner is a thin-walled can inverted over the specimen. This liner provides a confining and stabilizing effect upon the vapor refrigerant immediately surrounding the test specimen. The refrigerant, in the form of nitrogen vapor, enters the test chamber through a coil wound around the head of the top grip and escapes into the inner liner through the perforations in the bottom segment of the coil. This bottom segment is fitted with a light copper shield to eliminate any possibility of droplets of liquid nitrogen contacting the surface of the specimen when flow rates and temperature are such that they would permit liquid transfer to the test chamber. In addition to dispensing the cold vapor, the coil extracts heat coming in through the top grip thereby preventing conduction of heat to the specimen. After escaping through the perforations in the bottom coil segment, the cold, dense vapor passes down over the specimen and lower grip and out the open bottom of the inner liner. This vapor will tend to remain in the bottom of the test chamber until forced up by colder, denser vapor. During its short stay at the bottom of the test chamber, the vapor extracts heat coming in by conduction through the bottom specimen grip. The vapor is exhausted from the test chamber through a slightly oversized hole in the lid where the top grip enters. As the gas passes out around the top grip it extracts considerable heat that would otherwise be conducted into the test chamber. As a result of this directed vapor flow, the heads of the top and bottom grips, the specimen, and the inner liner are all kept at very nearly the same temperature.

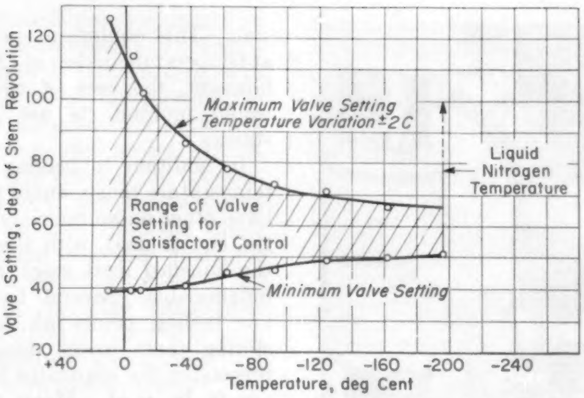

Fig. 4.—Range of Valve Settings Which Will Provide Control of Test Temperatures Within ±2 C.

The specimen used in this study was 3 in. long over-all with a 1.50-in. gage length of 0.252-in. diameter. The platform scale on which the Dewar rests was used for measuring nitrogen consumption and calibrating the needle valve but is not a necessary part of the low-temperature apparatus.

Performance

Before conducting any tests to evaluate the performance of this apparatus, minimum control standards were established. A maximum-temperature variation of ± 2 C during the on-off control cycle and a maximum temperature differential of 2 C over the gage length of the specimen were deemed permissible for ordinary tension testing purposes and were adopted as arbitrary limits.

Several components of the apparatus were found to influence the degree of control that could be attained. These included the type of controller used, location of the control thermocouple, location of the valves, length and insulation of transfer tubing, sensitivity of needle valve, and design of the test chamber.

A temperature controller with a rapid response was found desirable as there was a tendency for override during the control cycle. The 0-10 mv continuous-recording Micromax recorder-controller used with the apparatus was found to be satisfactory, but it is felt that better control could be obtained by using faster or anticipatory controllers. One type of anticipatory control (**6**) was tried and the temperature variation was substantially reduced. The exclusive use of an anticipator for this study was abandoned, however, in order to determine the capabilities of the apparatus using a standard controller. In order to adapt any standard-temperature controller for subzero temperatures, the thermocouple leads must be switched and, in the case of a two-position-type controller, the high and the low control circuit leads must also be interchanged.

The location of the control thermocouple was found to have some effect on the performance of the equipment. The best results were achieved when the thermocouple was at the top of the gage length near the point of entrance of the nitrogen vapor, although satisfactory results were obtained when it was mounted near the center of the specimen.

It is highly desirable to locate the needle valve and the magnetic valve as close as possible to the source of refrigerant. There are two reasons for this. First, the closer the needle valve is to the nitrogen supply the more con-

stant is the valve temperature and hence the more constant the conditions of flow through the valve. Second, when the magnetic valve is closed the nitrogen trapped under pressure in the line between it and the Dewar is absorbing considerable heat through the walls of the transfer tubing, and when the valve reopens this warmed refrigerant is first injected into the testing chamber. At the lowest temperatures the temperature of this refrigerant may actually be slightly above the temperature wanted on the specimen and the result is momentary warming instead of cooling. Mounting the valves on or very near the Dewar reduces the volume of this trapped coolant and reduces the cyclic fluctuations of temperature in the lower portion of the range. Warming of the refrigerant in the remainder of the transfer tubing may be reduced by similarly reducing the area through which heat may be introduced. Short, insulated lines and small-bodied valves help to reduce heat influx.

The temperature attainable and the variations of temperature during the on-off control cycle are essentially a function of the rate of nitrogen flow. The most important element governing this rate of flow is the needle valve. In order to establish the range of valve settings which would keep temperature fluctuations within the arbitrary limits of ±2 C, tests were conducted using a range of valve settings at various temperatures. Figure 4 shows the range of needle valve settings, in degrees, which produced satisfactory control. The maximum curve defines that valve setting above which a ±2 C temperature variation would be exceeded. The minimum curve determines the valve settings below which control is occasionally unsatisfactory, either because of sensitivity to external factors or because the nitrogen flow is insufficient to sustain the desired temperature. The actual temperature variation at the minimum curve ranges from $\pm\frac{1}{2}$ C at the higher temperatures to ±1 C at the lowest temperatures. The amount of temperature variation becomes progressively less as the valve setting is lowered from the maximum to the minimum curves.

It was observed that the amount of frost forming on the outside of the system was the most important external variable with respect to flow rates below the minimum values. For instance, during some tests, control with very little variation was maintained until vibration from the magnetic valve knocked frost off the valves and supply tube and permitted a more rapid influx of heat. This same valve setting would then not permit sufficient flow of nitrogen to maintain the set temperature. The loss of insulation in the form of frost did not have an appreciable effect on control when using valve settings at or above the minimum flow-rate curve.

As can be seen in Fig. 4, good temperature control at the lower temperatures requires setting valve openings rather accurately and a slow-opening needle valve is necessary to produce the required sensitivity. With constant pressure in the Dewar container, the rate of nitrogen flow is primarily a function of the size of the opening in the needle valve, although small variations in the temperature of the valve and refrigerant also have an effect. The openings in the needle valve were readily reproduced by means of the indicator wheel, each division of the indicator wheel being 3 deg of stem revolution. The needle valve was calibrated by setting the controller at a temperature below that of liquid nitrogen so the magnetic valve would remain open and the needle valve was then opened to various settings on the indicator wheel; accurate measurements of flow rates in terms of loss of weight of nitrogen from the Dewar per unit time were obtained for each valve setting. It was observed that the flow rate for any particular valve setting increased slightly as the temperature of the valve decreased. The rate of flow did not become constant until an equilibrium temperature had been established. Care was taken to make all calibration flow-rate measurements after the flow rates had become relatively constant. The calibration curve obtained in this manner is shown in Fig. 5.

The discontinuity in the curve of Fig. 5 can be explained as a transition where the state of the nitrogen flowing through the valve changes from gas to liquid. This discontinuity is characteristic of steady state flow. When operating at controlled temperatures, the flow of nitrogen is intermittent and there is no major discontinuity in the flow-rate curve. Furthermore, the average flow rate with intermittent flow and a fixed valve setting is variable depending upon many factors, and is quite different from that shown in Fig. 5. The valve calibration of Fig. 5 is intended as a reference to which the sensitivity of setting of other needle valves may be referred by similar calibration. Needle valves that are substantially faster opening than the one used would be unsatisfactory for regulating nitrogen flow in this apparatus.

Another factor to be considered is the influence of cooling rate on the total time required for achieving controlled low temperatures and for tension testing and also its influence on the quantity of nitrogen required. Temperature control within the prescribed limits was attained quite readily when using relatively small needle valve openings, though considerable time was required to reach the temperature desired. With larger needle valve openings the testing temperature was reached much more rapidly, but a soaking period was required to achieve control within the ±2 C limits. Somewhat less total time was required with the larger valve openings. Experiment showed that the best general practice for maximum economy of time and nitrogen, as well as for the best control, was to use relatively large valve openings during the

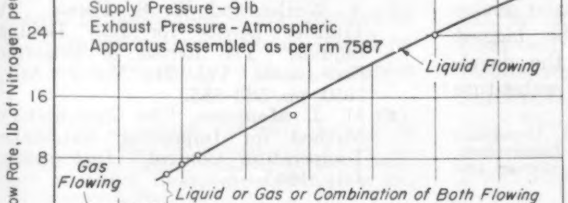

Fig. 5.—Calibration of Needle Valve Used as Flow Control Valve in Liquid Transfer Device for Low-Temperature Tension Testing Apparatus.

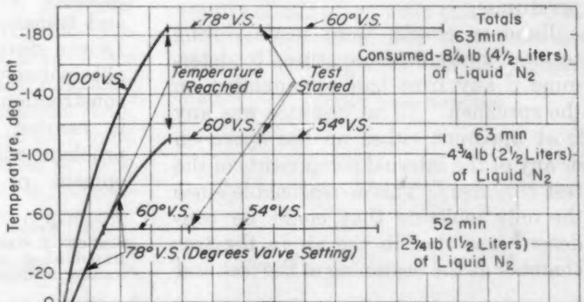

Fig. 6.—Typical Time-Temperature Curves for Subzero Tension Tests.

cool-down period and somewhat reduced openings for a soaking period of 10 to 15 min thereafter. The valve openings were then reduced to a setting near the lower curve in Fig. 4 for best control during the tension test. Typical runs are shown in Fig. 6. The run at −50 C required a total time of 52 min and consumed $2\frac{3}{4}$ lb ($1\frac{1}{2}$ liters) of liquid nitrogen. This included a 7-min cool-down period, a 15-min soaking time, and a testing time of 30 min. A similar run at −110 C using the same valve settings took 11 min longer to reach temperature and consumed an additional 2 lb of liquid nitrogen. A run at −185 C required larger valve settings in order to complete the run in the same time interval and used $3\frac{1}{2}$ lb more of liquid nitrogen than did the run at −110 C.

As illustrated in Fig. 4, tension tests can be conducted in nitrogen vapor anywhere in the range from room temperature to −195.6 C. Another important point shown by Fig. 4 is that adequate control can be obtained over at least a small range of valve openings at all temperatures. The minimum range is 15 deg of valve stem revolution and occurs at the lower temperatures. The existence of this range is indicative of the fact, proved by repeated tests, that adequate control can be easily and consistently obtained. Control was most difficult to attain between −190 and −195.6 C. Nevertheless, satisfactory temperature control was possible in this temperature range if sufficient time was permitted for the test chamber to reach equilibrium. This is because only small nitrogen flow rates are then required and the possibility of liquid transfer to the test chamber is lessened.

The temperature gradient over the length of the specimen was also observed and was found to be less than 1 C in most cases. In a few instances temperature gradients of as much as 2 C were observed in the lower temperature range of −190 to −195.6 C. However, with careful needle valve adjustment and longer soaking times all measurable gradients were eliminated at most temperatures.

Random checks were made during tests at various temperatures to determine if any frost had accumulated on the specimen. In no instance was any frost apparent either on the specimen or any of the internal components of the test chamber. This is reasonable since the only moisture that could be condensed was that in the air in the test chamber at the beginning of the test and the initial flow of warm nitrogen vapor flushed out this air before the chamber became cool enough to condense moisture.

In general, this testing system is simple and does not require highly trained personnel for its successful operation. Once the test apparatus is assembled there are only a few manipulations involved in attaining and controlling test temperatures. The predetermined test temperature is set on the controller and the needle valve is opened to a setting which produces the desired rapid cooling rate. The valve setting is reduced to a smaller value when the test temperature is reached and is further reduced to a setting within the satisfactory control range after an adequate soaking period. No further attention is necessary except for an occasional glance at the temperature controller's record to ascertain whether or not the apparatus is functioning properly.

Additional Applications

No attempts were made to use other refrigerants to obtain temperatures below −195.6 C; however, this possibility will be explored in the near future. Liquid hydrogen would be a good substitute for nitrogen were it not such an extremely active element. Hydrogen has a fairly high heat of vaporization (7.6 cal per cc) and boils at a much lower temperature (−252.8 C). Considerable caution would have to be exercised if hydrogen were used as a coolant, for any gas escaping from the system would be a hazard unless properly vented. Liquid helium, being inert, appears to be a more favorable substitute for testing at even lower temperatures, −268.6 C. The heat of vaporization of helium is very small, 0.9 cal per cc, and the equipment would require modification. In general, it would have to be reduced in size and insulated by vacuum using double-walled transfer tubes and test chamber. The use of liquid helium as a refrigerant has been made more feasible recently[3] by developments in storage and transfer devices. A liquid helium Dewar storage container is now available commercially and the design and construction of a liquid transfer device is nearing completion. The biggest problem will probably be the development of a satisfactory substitute for conventional thermocouples since they become ineffective at the lower temperatures (1).

[3] A. Wexler, Advisory Physicist, Cryogenics Section of Westinghouse Research Laboratories. Unpublished data regarding the storage and transfer of liquid helium.

Conclusions

It is felt that the apparatus and procedure for low-temperature tension testing described in this paper eliminates many of the undesirable features of previous methods and fulfills the requirements heretofore stated. Tests can be conducted at any temperature in the range from just below room temperature to −195.6 C with the possibility of lowering this bottom limit to the temperature of liquid helium, −268.6 C. Predetermined test temperatures are reached and stabilized quite readily, conveniently, and accurately with an automatic control and recording system. The effect of testing media is minimized because the dry nitrogen vapor employed as a surrounding and cooling medium is essentially the same as air and low-temperature test results are comparable to data from tests made in air at elevated and room temperatures. Finally, the equipment is simple and relatively inexpensive, and the cost per test of the liquid nitrogen is very modest.

Acknowledgments:

The authors wish to express their appreciation to G. H. Eichelman and A Wexler for helpful discussion and suggestions which greatly facilitated this work.

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An Inquiry Into the Reproducibility of Impact Test Results*

By H. L. Fry[1]

STEEL manufacturers in certain fields are being faced by a gradually increasing demand for materials that will meet specific minimum requirements on an impact test. Some specification writers and engineers seem to feel that the Charpy or the Izod test can be used as a suitable test for specifying steel. Articles have appeared recently in the literature purporting to provide a way to use an impact test in an exact and quantitative manner to specify steel of the proper toughness to withstand shock loading. A four-year study of the impact test at Bethlehem Steel Co. has convinced us that this tendency places an unwarranted confidence in the reliability of the impact test.

If a test is to be used for specifying material it is of fundamental importance that any two laboratories performing the test under suitably controlled conditions should be able to agree within reasonable limits as to the results of testing a particular material. This is not always true of the impact test.

One impact testing machine may be able to reproduce its own results with a satisfactory degree of precision, but differ widely from the equally reproducible results obtained on another machine. This can occur even though material and test conditions are the same and even though both machines are "accurate" as determined by available means of calibration. These same two machines may be found to agree with each other or to have reversed their relative positions when testing another material, or even the same material at a different temperature.

There is no such thing as a standard to which results on various machines may be referred and apparently no possibility of establishing such a standard.

Our study, on which the foregoing conclusion is based, has consisted mainly of performing a large number of comparative tests on various materials on five impact machines, with all variables controlled as closely as possible. Most of the work was done on keyhole-notch Charpy specimens, but Izod and V-notch Charpy specimens were also studied. Through the cooperation of other groups additional comparative tests have been made on several other machines.

Attempts have been made at Bethlehem to determine what feature of the design or behavior of the testing machines may be responsible for the wide divergence found among machines. In particular the high-speed motion picture camera has been used to observe the machine and specimen behavior.

Much has been written on the effects of variation in the technique of preparing specimens. While the author is aware of the possibility of these variations, the aim in the present investigation was to study the variations due to testing machines. In the data presented comparisons are made among several machines on groups of specimens. Every group is the same as every other group with which it is compared in respect to the manner and place of specimen preparation. Thus, the differences in specimen preparation were eliminated from this investigation.

Calibration of Machines:

The first step in the investigation was to calibrate each of the five machines in accordance with ASTM Tentative Method E 23 - 47 T.[2] This consists in checking dimensions and alignment of various parts and determining the accuracy of the energy measuring apparatus.

The machines all were found to be accurate in the useful range of the scale within 1 ft-lb or less after taking friction and windage losses into account. Incidentally, it might be mentioned here that ASTM Method E 23 states that an impact machine shall not have a percentage error greater than 1 per cent. Most Charpy and Izod machines can be read only to the nearest ft-lb, or at best $\frac{1}{2}$ ft-lb. The fact that some results are reported in tenths or even hundredths of a foot-pound is misleading. These decimal figures are merely the results of calculation in conversion from degrees to foot-pounds. It is therefore obvious that the smallest detectable error is more than 1 per cent in the useful range of the machine (from 0 to 50 ft-lb). Hence, the requirement of 1 per cent accuracy is obviously impossible and absurd when applied to machines of this type. We consider the degree of accuracy shown by these machines to be well within any reasonable tolerance.

The five machines conformed to the requirements of Method E 23 in regard to dimensions and alignment with the exception that on two machines there was an error slightly larger than is permissible in the location of the center of percussion with respect to the striking edge. A study of the results obtained on comparison tests did not indicate that this error had any significant effect.

Types of Machines:

Following is a list of the machines used in this study with the make and capacity of each.

Machine	Make	Capacity, ft-lb
A....	Tinius Olsen	264
B....	Tinius Olsen	264
C....	Sauveur & Boylston	226
D....	Tinius Olsen	240
E....	Riehle	220

Comparison Tests:

Two steels were used in making the comparison tests. One was a C1020 steel, normalized. The other was a 4340 steel, oil quenched and tempered. Tempering temperatures of 700 F and 1100 F were used on the 4340 steel to produce two different levels of impact.

Keyhole Charpy specimens from the C1020 steel were machined at six different plants. Then specimens from each plant were tested on each of the five machines. Figure 1 shows the results obtained on tests made at 70 F.

It is obvious at once that machines B and E tend to give considerably higher

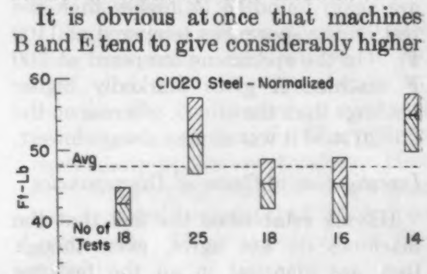

Fig. 1.—Keyhole Charpy Tests at 70 F.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at the Fifty-fifth Annual Meeting of the Society, June 23-27, 1952.

[1] Foreman, Special Tests, Bethlehem Steel Co., Bethlehem, Pa.

[2] Tentative Methods of Impact Testing of Metallic Materials (E 23 - 47 T), 1949 Book of ASTM Standards, Part 1, p. 1287; Part 2, p. 1035.

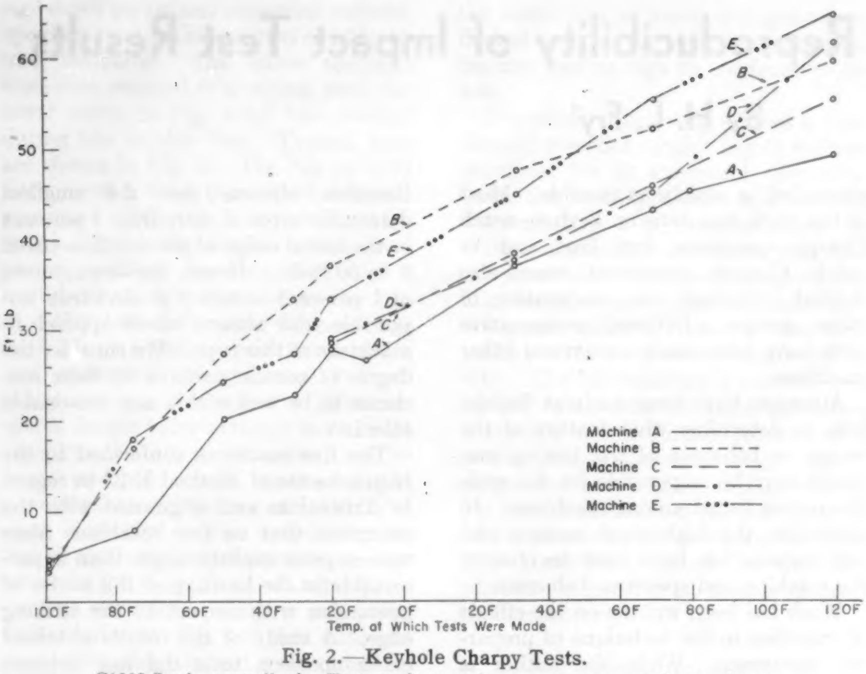

Fig. 2.—Keyhole Charpy Tests.

C1020 Steel—normalized. Tests made at various temperatures on five machines.

results than the others, and machine A tends to be somewhat lower than the rest. Preparation of specimens at different plants was found to have no very marked influence. This is evident from the fact that the scatter of results on each machine is small compared to the differences in range to be found among the different machines.

This whole group of tests was carried out three times with substantially the same results.

Similar groups of tests from the same material were made at other temperatures. The average results of all tests are shown in Fig. 2. Here it is seen that the machines do not agree at any but the lowest temperature. It may be noted particularly that the order of values is not always the same. In several instances two machines are found to have reversed their relative positions in going from one temperature to another.

On the 4340 steel, keyhole Charpy tests were carried out at 70 F. In these tests (see Fig. 3) machines B and E are again found to be higher than the rest on the specimens tempered at 1100 F. On the specimens tempered at 700 F machine A gives markedly higher readings than the others, whereas on the C1020 steel it was almost always lowest.

Investigation of Cause of Discrepancies:

Having established the fact that the machines do not agree, even though they are identical in all the features covered by specification, our next concern has been to find the cause and, if possible, the correction of the trouble.

We have assumed that when identical specimens are broken in two machines, with different results, the amount of energy required to produce the fracture of both specimens is the same, and that the machine which gives the higher reading uses up or loses more energy than the other machine in some way other than in breaking the specimen. Following are listed all of the possible ways in which the energy of the pendulum can be used, besides breaking the specimens.

1. To overcome air resistance and bearing friction.
2. To impart a velocity to the broken ends of the specimen.
3. To impart vibration to various parts of the machine and its foundation.
4. To deform the specimen at the points of contact with specimen supports and knife edge.
5. To deform parts of the machine.
6. To overcome interference due to broken ends of the specimen getting between the pendulum and the frame of the machine.

The first two items can be ruled out at once as sources of error. The friction and windage loss has been measured and applied as a correction to the scale. The maximum energy used to impart a velocity to the specimen is well under 1 ft-lb.

The third item, vibration of the machine and its foundation, has been at least partially ruled out in our work. One of our machines which had been giving consistently higher results than average on a group of tests, was mounted on a wooden floor, a very unstable foundation. It was transferred to a concrete base but the results were the same. If transmission of vibration to the base had been a factor in producing the high results then the transfer to another base should have had some effect.

The deformation of specimen ends and machine parts at the points of contact does not seem a likely source of the large discrepancies, since the points of contact have the same form and dimensions on all machines.

The most likely source of the discrepancies has appeared to us to be the sixth item on the list, interference between the specimen ends and the pendulum. One way that occurred to us to investigate this source of error was to take high-speed motion pictures of specimens being broken, to see whether such interference could actually be observed.

A number of high-speed motion pictures have been taken, and these give evidence that there may be considerable energy involved in getting the broken ends of the specimen through the clearance between the specimen supports and the striking edge of the pendulum. The pictures suggest that an improvement could be made by increasing the

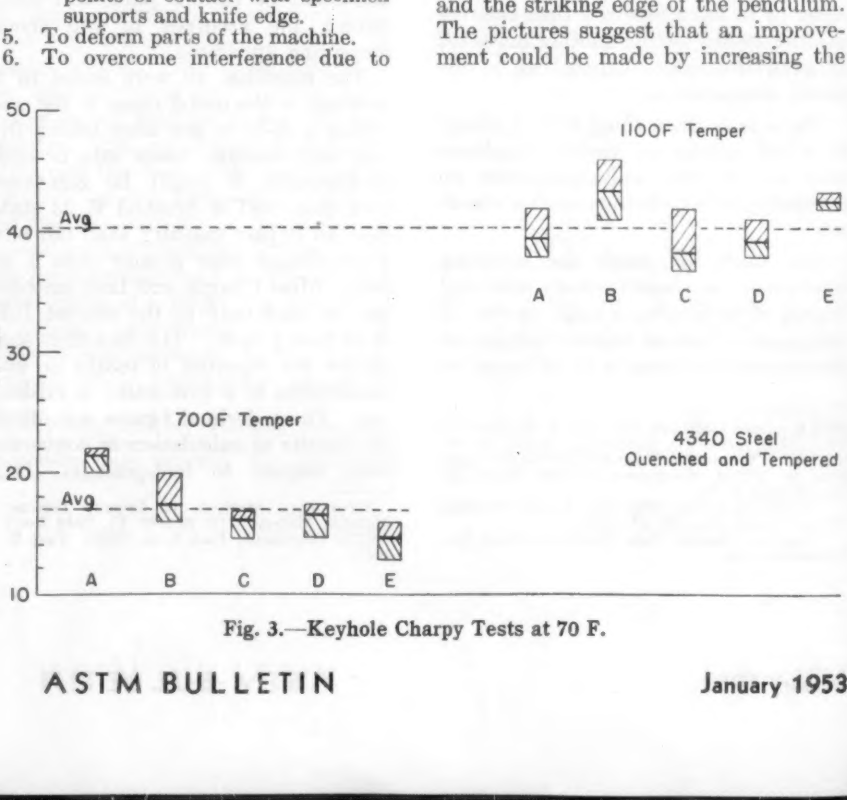

Fig. 3.—Keyhole Charpy Tests at 70 F.

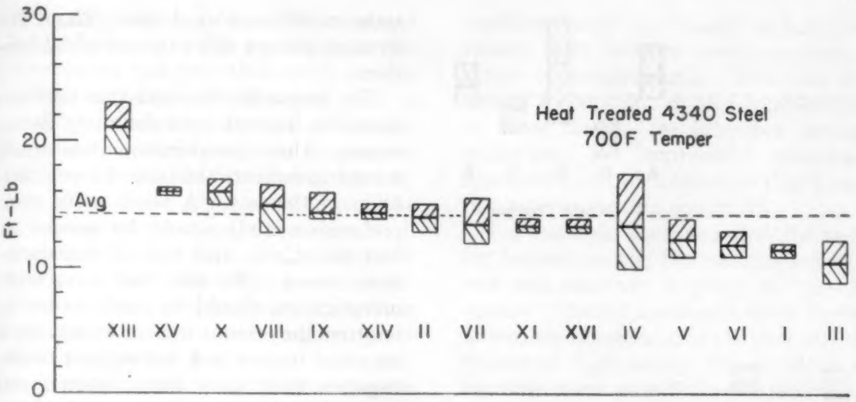

Fig. 4.—Forging Manufacturer's Assn. Tests.
Keyhole notch Charpys at room temperature.

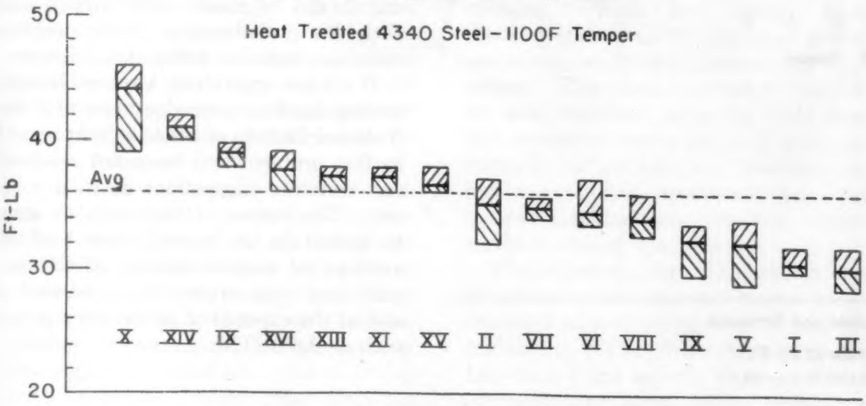

Fig. 5.—Forging Manufacturer's Assn. Tests.
Keyhole notch Charpys at room temperature.

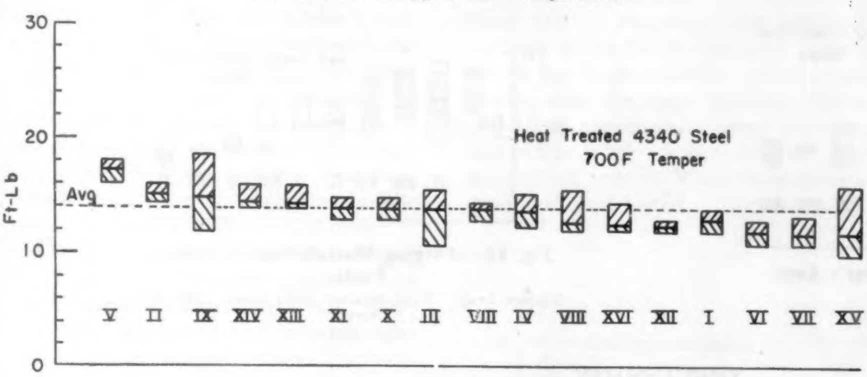

Fig. 6.—Forging Manufacturer's Assn. Tests.
V-notch Charpys at room temperature

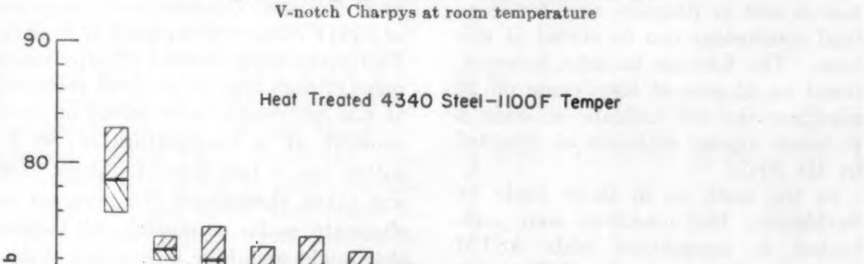

Fig. 7.—Forging Manufacturer's Assn. Tests.
V-notch Charpys at room temperature

clearance, particularly by reducing the angle of the striking edge on the Charpy test and perhaps also by increasing the radius of the edge of the specimen supports.

If it was possible to measure the amount of energy loss due to the lack of good clearance, it might develop that a difference would be found between machines. One attempt at such a measurement was made, but this only showed that extreme refinement in the means of measurement would be necessary to produce a useful result.

Investigation by Others:

In addition to our own work on this subject, Bethlehem Steel Co. has also cooperated recently in similar work by the Forging Manufacturer's Assn.

The Forging Manufacturer's Assn. has made some comparative impact tests involving comparisons among the five machines covered in our studies and the machines in a number of other laboratories. Comparison tests were made on 4340 steel similar to that used in our studies. All material was treated at one laboratory but each laboratory machined and tested its own specimens. Results that have been reported by the Forging Manufacturer's Assn. are shown in Figs. 4, 5, 6, and 7. These show results on keyhole and V-notch Charpy specimens. These show even wider discrepancies than were shown in our own studies.

Izod Tests:

Considering the different manner of breaking the specimen it seemed possible to us that the Izod test might be more reliable than the Charpy test. We therefore made comparative tests on five Izod machines. These were the same five machines as were used for Charpy tests with the exception of machine C, which could not be used for Izod testing. Another machine of 120 ft-lb capacity built by F. H. Bultman Co. was used instead and was designated as machine C1. On the four other machines the pendulum was swung from a lower position, making the capacity of each machine 120 ft-lb.

Tests were made on the 4340 steel using tempering temperatures of 700, 1000, and 1100 F. The results are shown in Fig. 8. These show somewhat better agreement than the Charpy tests, particularly at the lower values. However, the Forging Manufacturer's Assn. has reported values that show poor agreement. These are shown in Figs. 9 and 10.

Summary and Discussion:

This investigation has brought out clearly that there are large differences between the results obtained on impact

tests on different machines. These differences are not due to errors of calibration.

The reason for the variation between machines has not been definitely determined. Our investigation has only served to indicate the lack of reproducibility of the test. A much more comprehensive study would be needed to find the causes and cure of the variations found. We feel that some such investigation should be made to try to improve the present tests or to develop a standard impact test not subject to the vagaries that have been pointed out here. In the meantime use of the present impact tests in acceptance testing should be made with caution and with due consideration of the possible variation between different machines.

We have consulted various impact testing machine manufacturers and the National Bureau of Standards in regard to this problem and have not received any concrete suggestions as to a solution. The Bureau of Standards is willing to undertake an investigation and an attempt at standardization of the impact test only under the sponsorship and at the expense of an industry group such as the ASTM.

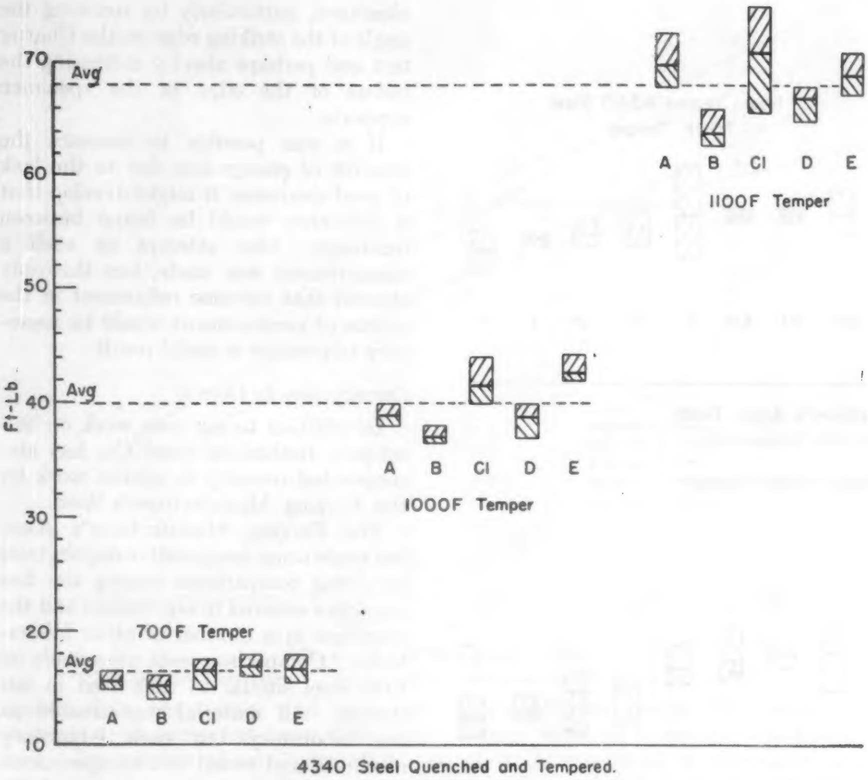

Fig. 8.—Izod Tests at 70 F.
4340 steel quenched and tempered.

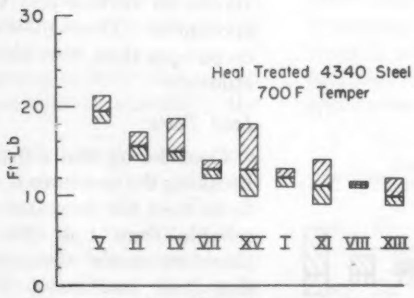

Fig. 9.—Forging Manufacturer's Assn. Tests.
Square Izod.

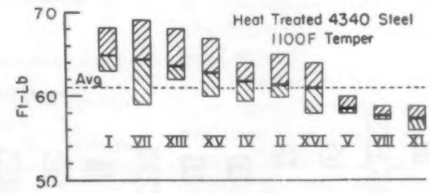

Fig. 10.—Forging Manufacturer's Assn. Tests.
Square Izod. Heat treated 4340 steel, 1100 F temp.

DISCUSSION

Messrs. W. H. Mayo,[1] A. B. Wilder,[1] and R. L. Rickett[2] (*presented in written form*).—Since the notched-bar impact test has been used for many years both for research work and in meeting specification requirements, the reliability of impact testing machines is a matter of vital interest to many of the units of the United States Steel Co. Several years ago when the question of variations between machines came up there was undertaken a systematic investigation to compare a number of machines used in the laboratories of the company. This investigation is still in progress, and hence no final conclusions can be stated at this time. The findings to date, however, based on 21 sets of tests made on 20 machines do not indicate as wide a variation among machines as reported by Mr. Fry.

In the tests, as in those made by Bethlehem, the machines were calibrated in accordance with ASTM Tentative Methods E 23 – 47 T[3] and in most instances were in reasonable agreement with this method with respect to alignment, anvil span, anvil radius, and tup radius. Two types of steel have been tested thus far, ship plate (Rockwell hardness 70 to 75 B) and Steel No. 4340 quenched and tempered at 1050 F (Rockwell hardness 37 to 40 c). Thirty-two keyhole-notch Charpy specimens of each type of steel, all prepared at one laboratory, were tested on each machine at a temperature of 80 F, within one or two degrees. Great care was taken throughout the program to eliminate, so far as possible, all factors that might give false indications of differences among machines. To this end, the specimens were thoroughly randomized with respect to location in section of plate or bar, order of notching, and order of testing.

As shown in Fig. 11, the over-all range in average Charpy values for the 21 sets of tests (64 tests each) was

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[2] Assistant Supervisor, Research Laboratory, United States Steel Co., Kearny, N. J.

[3] Tentative Methods of Impact Testing of Metallic Materials (E 23 – 47 T), 1949 Book of ASTM Standards, Part 1, p. 1287.

approximately 4 ft-lb, at an average level of 25 ft-lb. The sensitivity of the experiment was such that much smaller differences could be detected, and a number of small but real differences among the machines were found. In agreement with the findings reported by Mr. Fry, these differences among the machines were not quite the same in all instances for the two different types of steel; in the United States Steel tests, however, the general order of ranking the machines did not differ greatly for the two types of steel.

As yet, there is no explanation for the small but real differences in behavior of the impact machines disclosed by the investigation described. Additional work is now being carried out by the research and plant laboratories which should extend knowledge of the variability of impact testing machines and perhaps reveal some of the reasons for such variations.

To date the impact test has been found to be the most reliable and practical test for indicating an acceptable level of toughness in steel. In view of its rather wide acceptance, it is felt that ample opportunity should be given for further investigation into the causes of the apparent variations, some of which may be due to factors other than the machines themselves.

Mr. David E. Driscoll (*presented in written form*).[4]—The author tells a very convincing story, but unfortunately he tells only part of the story. His statements on the variations in impact results obtained on the five machines at the Bethlehem plant and in the survey conducted by the Forging Manufacturers Assn. shows very clearly the scatter in results often encountered.

The Watertown Arsenal Laboratory participated in the survey conducted by the Forging Manufacturers Assn.; after the report was published, a representative of the Watertown Arsenal Laboratory visited one of the participating installations which had shown a deviation of 26 per cent from the average. A study of the Charpy machine involved showed that the machine was not in proper operating condition and that the proper techniques were not being observed. When these conditions were corrected, a group of 80 specimens obtained from gun tubes were tested in this machine and the same number in one of the Charpy machines at the Watertown Arsenal Laboratory. The average of the results showed a spread of 1 per cent (12.20 to 12.07 ft-lb) between the two machines.

The author also mentions that there have been several instances where two machines have been found to have reversed their relative positions over a range of temperatures. This can be caused by any one or any combination of three things, (*a*) improper testing technique, (*b*) improperly machined specimens, and (*c*) a machine that is not in proper operating condition.

For example, assuming that the testing techniques and the machine are correct and accurate, a group of "out-of-square" Charpy specimens when tested at various temperatures will give correct values at high energy levels (ductile) because there is sufficient ductility at these energy levels to start the broken specimens through the supports without spinning. With low energy level (brittle) specimens the spinning action can occur, resulting in erroneously high values. This alone could be responsible for two machines reversing their relative positions over a range of temperatures, if one machine was breaking correctly machined specimens and the second machine was breaking incorrectly machined specimens.

The statement that "the deformation of specimen ends does not seem a likely source of large discrepancies" is entirely misleading. The Watertown Arsenal Laboratory has records showing that a company producing armor plate was consistently reporting Charpy values of 55 ft-lb. A representative visited the plant and on examining the fractured surfaces immediately realized that it would be impossible to obtain such values with the type fracture shown. (All these specimens showed deformation of the ends.) A section of the plate was cut off, sent to Watertown Arsenal machined, and tested. The results obtained varied from 4.5 to 5.5 ft-lb. This discrepancy of 1000 per cent certainly is enough to call "a large discrepancy."

The Watertown Arsenal Laboratory has checked machines in various parts of the country and has found that when correct techniques are used and the machine is in proper working condition, the Charpy impact results obtained on the various machines are comparable.

Mr. H. W. Wyatt (*presented in written form*).[5]—Quoting from the paper, "The most likely source of the discrepancies has appeared to us to be the sixth item on the list, interference between the specimen ends and the pendulum." This interference is used as an explanation for discrepancies of results in the Charpy type of test. The data of the paper and other data also indicate that in the Izod type of test where interference does not occur in the same discrepancies appear. It would seem to follow then that there is a possibility that interference is not the most likely explanation of variation in results.

It might be interesting to investigate the frequency of the vibrations set up in the hammer as the specimen is fractured. The variation in energy absorption with different frequencies of vibration might be quite high and account for the discrepancies in results.

Mr. T. McLean Jasper (*presented in written form*).[6]—The amount of confusion that has been created by the notch impact bend test has been costly. It is a test which when used carelessly

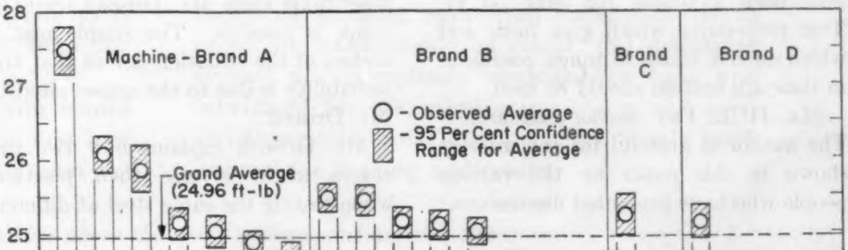

Fig. 11.—Over-all Average of Charpy Values (64 tests) by machines.

[4] Chief, Mechanical Testing Section, Watertown Arsenal, Watertown, Mass.

[5] The Lunkenheimer Co., Cincinnati, Ohio.

[6] Engineering Consultant, A. O. Smith Corp., Milwaukee, Wis.

can create very much hardship without adding a commensurate value.

There are vagaries which are associated with the test as separated from the one which this paper presents. These were presented in the discussion of H. C. Boardman's interpretive report on pages 297S–299S of the Welding Research Supplement of *The Welding Journal* for June, 1951.

A test which indicates the brittleness of materials should be a part of the test program for steel acceptance. The general test that engineers have had up to the present is that of per cent elongation and reduction of area. An additional test for railroad rails involves the dropping of a 2000-lb tup at various heights, depending on the weight of the rail. The energy, for acceptance of the normal rail weights used, varies from 32,000 to 44,000 ft-lb without fracture. S. W. Lyon, one of the members of the group investigating transverse fissures in railroad rails, obtained the Izod notch values from 289 test rails, and they varied in energy between 1.55 and 1.64 ft-lb on those that had successfully passed the drop test. Other tests using the Charpy impact bend notched bar averaged from 1 to 3 ft-lb.

The above acceptance test on rails seems adequate, but the notch impact tests indicate that they cannot be used to simulate the demands on rail service. Rail temperatures may also be very low at times.

Many metals necessary to the successful service demands on industry are very brittle. In spite of this brittleness, other qualities are often more important to their application. When a material is good in its own right can such a test as the notch impact bend be used to throw them out after successful service for a long time?

These notch impact bend tests have now been available for over 50 yr. Test procedures which give faith and which do not cause so much confusion in their application should be used.

Mr. H. L. Fry (*author's closure*).—The author is grateful for the interest shown in this paper by the various people who have presented discussions.

The investigation made by the United States Steel Co. and mentioned in the discussion by Messrs. Mayo, Wilder, and Rickett is of particular interest. It is hoped that the complete results of this investigation will be published, as they will certainly add to our knowledge of the subject.

The authors of this discussion point out that the variability which they found was not so great as that which was found at Bethlehem. However, they also point out that the two steels they tested showed differences in variability among the machines. Some of our work confirmed this. It seems possible that the differences between our work and theirs may be within the range of this possible variation among steels.

Mr. Driscoll seems to have misunderstood the purpose and nature of the investigation. The author is well aware that improper testing technique, improperly machined specimens, and machines that are not in proper operating condition can play havoc with impact test results. This investigation was conducted to determine the variability of machines when proper testing technique, properly machined specimens, and machines in proper operating condition are used.

In our work the same technique was used on all tests; the specimens were all within dimensional tolerances and besides were randomized or were distributed among the machines so that each machine tested specimens from all of the different sources; and the machines were all carefully checked and found to be in proper operating condition. The author is confident that in the work at United States Steel, equally great care was given to these conditions. And yet there was a definite degree of variability among machines, of a greater magnitude than Mr. Driscoll seems to think is possible. The simple mathematics of the situation denies that this variability is due to the causes cited by Mr. Driscoll.

Mr. Driscoll explains how two machines might reverse their positions when testing the same steel at different temperatures. His explanation rests on the assumption that one machine is testing out-of-square specimens and the other square specimens. He fails to explain the unbelievable circumstance that a random selection of a large number of specimens from a group should assign all the out-of-square specimens to one machine and the square ones to another.

The author would like to call to Mr. Driscoll's attention the fact that the Watervliet Arsenal has recently published results of a comparative study of impact machines, in which the Watertown Arsenal participated. This study also shows a considerable degree of variability among machines.

The sentence from the author's paper quoted by Mr. Wyatt was given as an explanation of our decision to study the test by means of the high-speed motion picture camera. It was not our final conclusion that interference was the sole cause of discrepancies.

It would be interesting to study vibrations in various parts of the machine as suggested by Mr. Wyatt. However, there would be immense difficulty in interpreting the results of such a study to explain discrepancies between machines of greatly divergent designs.

Mr. Jasper brings out a point that is beyond the scope of this paper: the need for care in interpretation of impact test results. Proper interpretation is a highly important question, but it is one that seems to have received more attention than the question of the reliability of results. For example, there is an excellent discussion of this phase in the section on Significance in the ASTM Tentative Methods of Impact Testing of Metallic Materials (E 23 – 47 T).

In closing, the author wishes to emphasize that the objective in presenting this paper is not to discourage the use of the impact test, but to point out that there is danger in its use as an acceptance test without recognition of the fact that at present it seems to be inherently more variable than such tests as the tensile or the hardness test.

There is need for considerable investigation of the causes of variability.

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

L. D. Andrews has been appointed Director of Research and Engineering on Magnetic Materials for Stackpole Carbon Co., St. Marys, Pa.

Fred W. Barlow, formerly in charge of Rubber and Plastics Testing Lab., Cabot Carbon Co., Pampa, Tex., has been transferred to the English subsidiary plant of his company, Cabot Carbon Ltd., in Stanlow, Ellesmere Port, Cheshire, where he assumes the duties of Technical Manager.

Donald P. Boaz is now affiliated with the Jones Dabney Div., DeVoe & Raynolds Co., Inc., Louisville, Ky., as Enamel Formulator. Until recently he was Technical Director, Texline Paint Mfg. Co., Dallas, Tex.

Wallace R. Brode, Associate Director, National Bureau of Standards, Washington, D. C., is one of eight ACS members recently appointed to serve on the first editorial advisory board of the *Advances in Chemistry Series.* Inaugurated in 1949, the series was established originally to provide a medium for the publication of symposiums and collections of ACS meeting papers which did not fit into the editorial scope of the existing ACS journals. **Frederick D. Rossini,** Director of the API Research Laboratory, Carnegie Institute of Technology, Pittsburgh, Pa., also is one of the appointees on this board.

H. G. Burnham, for many years Engineer of Tests, Northern Pacific Railway Co., St. Paul, Minn., recently retired. A long-time member of ASTM, his affiliation dating from 1913, Mr. Burnham served on a number of the technical groups, his activities being especially concentrated in Committees A-1 on Steel, A-2 on Wrought Iron, and D-1 on Paint. **H. B. Hoesly** succeeds Mr. Burnham as Engineer of Tests for Northern Pacific, and as representative of the company in the Society.

William H. Cady is now Editor, Technical Manual and Year Book, American Association of Textile Chemists and Colorists. He was formerly Consultant, U. S. Finishing Co., Norwich, Conn.

Charles T. Evans, Jr., for some time Director of Development and Metallurgy, Elliott Co., Jeannette, Pa., has been named Manager of High-Temperature Metals, Universal-Cyclops Steel Corp., Bridgeville, Pa. Mr. Evans heads the Gas Turbine Panel of the Joint Committee on Effect of Temperature.

Homer G. Farmer, for many years Technical Service Director, Universal Atlas Cement Co., New York City, retired as of Dec. 31, 1952.

Ephraim Freedman, Director, Macy Bureau of Standards, R. H. Macy and Co., Inc., New York City, played an important role in a holiday emergency when he contributed his testing knowledge and skill in the analysis of the liquid in the bubbling, colored lights on the Christmas tree of a Toledo (Ohio) family where the 20-month-old baby girl had been tempted to drink of the "sparkler." Following an emergency call from the Toledo physician and unsuccessful attempts of the New York Police Headquarters to contact the manufacturer of the item, R. H. Macy & Co. were approached as a distributor, and Mr. Freedman responded within ten minutes to the request for analysis of the liquid, the report being relayed to the doctor who began treatment on the basis that the ornament contained methylene chloride (a compound capable of seriously affecting breathing and nerve centers). The analysis was later confirmed by the technical engineer of the manufacturer. The child, who had developed convulsions and had been in critical condition when hospitalized, was responding to treatment, according to the New York paper reporting the incident.

A. W. Gauger, for 21 years Director, Mineral Industries Experiment Station, The Pennsylvania State College, has retired from Penn State, and has accepted appointment as Visiting Professor of Fuel Technology at the University of Concepcion, in Chile. "Al" and his family have "taken off" to South America, and in his unique Christmas message to the ASTM Staff he expresses the hope that his friends in this hemisphere—"all you Norte Americanos"—will write to him (in care of Facultad de Ciencias Fisicas y Matematicas, Universidad de Concepcion, Casilla 783, Concepcion, Chile).

J. A. Hartley has retired as President, Braun Corp., Los Angeles, Calif. He is succeeded by Don Hense. Mr. Hartley's son, A. A. Hartley, has been named Vice-President.

Victor Hicks is now associated with Allen-Bradley Co., Milwaukee, Wis., as Physicist.

Carl A. Menzel, formerly Manager, Housing and Cement Products Bureau, Portland Cement Assn., Chicago, Ill., has been appointed Consultant on Concrete Technical Problems.

D. F. Murphy, until recently Chief Metallurgical Engineer, Besser Manufacturing Co., Alpena, Mich., is now serving on the technical staff of the Champion Forge Co., Cleveland, Ohio, in a similar capacity.

Harold Perrine, has been appointed Manager, Unarco Steel Building Div., Union Asbestos & Rubber Co., Chicago, Ill. For the past 17 years he had been associated with Owens-Illinois Glass Co. and Owens-Corning Fiberglas Corp., Toledo, Ohio.

Irving Roberts, formerly with the Elliott Co., Research and Development Dept., Jeannette, Pa., and more recently consulting engineer, has established his practice in Meadowbrook, Pa. Mr. Roberts is Chairman of the Low Temperature Panel of the Joint Committee on Effect of Temperature.

Rudolph A. Schatzel, Vice-President and Director of Engineering, Rome Cable Corp., Rome, N. Y., has been elected President of the Board of Directors of the Central New York School for the Deaf (in Rome). A native of Kingston, N. Y., but a resident of Rome since 1924, Mr. Schatzel has taken a great interest in community affairs, particularly those of an educational and character-building nature, having served terms as director and president of the Y.M.C.A., the Boy Scouts Council, and the Board of Education of his adopted city. Active in ASTM for many years in technical committee work, he is presently serving a term on the Board of Directors of the Society.

W. E. Santoro has been appointed Head, Research Div., The Monroe Sander Corp., Long Island City, N. Y. He had been associated for some years with the Standard-Toch Chemical Co.

S. W. Shepard, until recently Chief Metallurgist, American Cyanamid Co., New York City, is now with the Chemical Construction Corp., Linden, N. J.

E. I. Shobert has been appointed Manager of Carbon Research and Engineering for Stackpole Carbon Co., St. Marys, Pa.

George M. Sinclair has accepted a position as Research Engineer, Westinghouse Research Labs., Metallurgical & Ceramic Dept., Westinghouse Electric Corp., East Pittsburgh, Pa. He was formerly Research Assistant at the University of Illinois.

Foster Dee Snell, President, Foster D. Snell, Inc., New York City, has been elected President of the Association of Consulting Chemists and Chemical Engineers.

Robert B. Sosman, Professor in School of Ceramics, Rutgers University, and noted ceramist and authority on silica and refractories, has been named the 1953 recipient of the Albert Victor Bleininger Award. This Award, given annually by the Pittsburgh Section of the American Ceramic Society, is the highest honor conferred in this country for "distinguished achievement in the field of ceramics." The medal and scroll, representing the Award, will be presented to Dr. Sosman at a dinner to be held at the Hotel Schenley (Pittsburgh) on March 13, 1953. In ASTM Dr. Sosman has rendered important service in Committee C-8 on Refractories, heading this group as Chairman since 1948.

John R. Townsend, nationally known materials expert and Director of Materials Applications Engineering, Bell Telephone Laboratories, Murray Hill, N. J., has been named Director of Materials and Standards Engineering of the Sandia Corporation, Albuquerque, N. M. While

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(*Continued from page 70*)

fulfilling his new duties Mr. Townsend will be on a special leave of absence from the Laboratories. A Past-President of ASTM, he is Chairman of the Standards Council of the American Standards Assn. He organized and is a member of the Committee on Materials, Research and Development Board; and is a member of the Minerals and Metals Advisory Board of the National Academy of Sciences. During 1952 he organized the American-British-Canadian Committee on Engineering Standards. Mr. Townsend is the recipient of the ASTM Dudley Medal (1930), and a number of awards and citations for his contributions to the materials field, both civilian and military.

Bernard Vonnegut, well known for his pioneering work in "rain-making," recently joined the Physical Chemistry Group of Arthur D. Little, Inc., Cambridge, Mass., consulting research and engineering organization. He had been associated previously with the research departments of General Electric Co., the Preston Laboratories, and the Hartford Empire Co.

NECROLOGY . .

The death of the following members has been reported

EDWIN H. FOX, General Manager, The Cincinnati Concrete Pipe Co., Cincinnati, Ohio. Member since 1950.

JOSEPH MATTE, JR., Chief Structural Engineer, Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich. (September 5, 1952). Member since 1953.

SELAH S. TOMKINS, Chemical Engineer, Consolidated Edison Co. of New York, Inc., New York City (October 28, 1952). Member since 1920, and representative of his company on the following committees and numerous subgroups for many years: D-3 on Gaseous Fuels, D-5 on Coal and Coke, D-16 on Industrial Aromatic Hydrocarbons and Related Materials, and D-19 on Industrial Water.

HEWITT WILSON, Regional Director, Region VII, U. S. Bureau of Mines, Norris, Tenn. (circa 12/1/52). Member since 1933, and member of Committees C-8 on Refractories and C-21 on Ceramic Whiteware for many years. (See accompanying article).

CLEMENT T. WISKOCIL, Professor of Civil Engineering, University of California, Berkeley (October 30, 1952). Member since 1916. (See accompanying article.)

Hewitt Wilson

HEWITT WILSON, Regional Director, Region VII, U. S. Bureau of Mines, Norris, Tenn., passed away November 25, 1952, while vacationing at Fullerton, Calif. He was Supervising Engineer of the Electrotechnical Laboratory in Norris for 11 years prior to appointment as Regional Director in 1949. Previously he had served as consultant for the Bureau for 30 years, during which time he also headed the Division of Ceramic Engineering, University of Washington, Seattle. Following his graduation from Ohio State University in 1913 he served as Professor of Ceramics at his alma mater for several years. In his service with the Bureau he had directed research on the development of an all-American dinnerware, use of electric firing for ceramic ware, special ceramic parts for the Oak Ridge National Laboratory, recovery of aluminum from clays and magnesium from olivine, the synthesis of refractory materials such as mullite and forsterite in an electric arc-resistance furnace, synthesis of mica and cordierite, and the development of lightweight aggregate for concrete. An international authority on ceramic and nonmetallic materials, Dr. Wilson was author or co-author of numerous technical articles, and author of the widely used book, "Ceramics—Clay Technology." A member of ASTM since 1933, he was active in Committees C-8 on Refractories and C-21 on Ceramic Whiteware through the years. He also had been a very active member of the American Ceramic Society. As stated by one of his co-workers, in Dr. Wilson's passing "the scientific world has lost a true scientist and his many associates, a true and understanding friend."

Clement T. Wiskocil

CLEMENT T. WISKOCIL, Professor of Civil Engineering, University of California, Berkeley (October 31, 1952). A member of ASTM since 1916, Professor Wiskocil also had been affiliated with numerous other engineering societies. He was a Past-Chairman of the Pacific Southwest Section of ASEE, and Past-President of the San Francisco Section of ASCE. A graduate of the University of Wisconsin, he was on the faculty of the College of Engineering of the University of California for the past 38 years. Recognized as an outstanding teacher in Civil Engineering subjects, and a friend and counsellor of the students he was particularly interested in engineering ethics, serving for many years as Faculty Adviser to certain of the honor societies and student engineering chapters. In January, 1952, the Student Chapter of ASCE at the University of California honored him with a dinner in appreciation of contributions as adviser during the last quarter-century. Professor Wiskocil also was co-author of the book, "Testing and Inspection of Engineering Materials."

NEW MEMBERS . . .

The following 17 members were elected from November 13 to December 15, 1952, making the total membership 7363 . . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first then individuals.

Chicago District

ZONOLITE CO., Eugene L. Perrine, Senior Physicist, 1827 Benson Ave., Evanston, Ill.

FLAD, THOMAS H., Architect, John J. Flad and Associates, 908 W. Johnson St., Madison, Wis.

WALLING, LEWIS G., Plant Laboratory Engineer, Phelps Dodge Copper Products Corp., Inca Manufacturing Div., Fort Wayne 1, Ind.

Cleveland District

MORRIS, WALTER J., Consultant, Tempel Manufacturing Co., 1939 Bryn Mawr Ave., Chicago, Ill. For mail: 2986 Crescent Dr., N. E., Warren, Ohio.

Detroit District

EARDLEY, E. H., Chief Structural Engineer, Albert Kahn Associates, Architects and Engineers, Inc., 345 New Center Bldg., Detroit 2, Mich.

New York District

DUBIN, LESTER, Chief Engineer, Lambda Electronics Corp., 103-02 Northern Blvd., Corona 68, N. Y.

STULEN, FOSTER B., Chief Structures Engineer, Curtiss-Wright Corp., Propeller Div., Caldwell, N. J. For mail: 140 Ridgeview Pl., Boonton, N. J.

Pittsburgh District

STEIN, FRANZ H., Technician, H. L. Seabright Co., Wheeling, W. Va. For mail: 156 Kruger St., Elm Grove, W. Va.

Southern California District

ROOD, ASHTON, Techkote Co., Inc., 820 W. Manchester Ave., Inglewood 1, Calif.

Western, N. Y.-Ontario District

HARTSHORN, R., Crouse-Hinds Co., Wolf & Seventh North Sts., Syracuse 1, N. Y.

U. S. and Possessions

TEXAS INDUSTRIES, INC., Cedric Willson, Vice-President and Chief Engineer, 400 First National Bank Bldg., Dallas 1, Tex.

LOUISIANA STATE UNIVERSITY LIBRARY, Serials Division, Baton Rouge 3, La.

MCGOWAN, P. L., Office Manager, Pittsburgh Testing Laboratory, 5190 Scenic Highway, Baton Rouge, La.

MYHRE, S. HERBERT, 1707½ Fifteenth Ave., N. W., Seattle, Wash.

SCHARMAN, KENNETH S., Engineer, Sanitary District No. 1 of Pima County, 80 N. Church St., Tucson, Ariz.

Other than U. S. Possessions

FORD MOTOR CO. OF INDIA, LTD., Mocherla K. Raju, Purchasing Agent, Box 499, Queens Rd., Bombay, India.

GAS DYNAMICS LABORATORY, MCGILL UNIVERSITY, R. E. Chant, Project Engineer, Macdonald College, Ste. Anne de Bellevue, P. Q., Canada.

Research Expands at Franklin Institute

CONTINUED expansion of the volume of industrial and Government sponsored research carried on at the Research and Development Laboratories of Philadelphia's Franklin Institute resulted in the purchase and renovation of additional property for laboratory facilities. This brings the Institute's total laboratory space to more than 70,000 square feet, or about 1½ acres.

NEWS NOTES ON

Laboratory Supplies and Testing Equipment

Instrument Notes

Vibration Fatigue Testing Machine—The Model 100 HL-A Vibration Fatigue Testing Machine has recently been introduced. The new machine is an improved version of its predecessor, the Model 100 HA. Announced as outstanding among improvements is the method of table support. Four linkage arms, equipped with ground steel pins and bushings, support the table; a method proved more efficient and serviceable. Ball tracks have been eliminated. Bearing contact has been increased fivefold. Another improvement—the table has tapped mounting holes, jig-drilled in a symmetric pattern, so that the object being tested (or fixture for holding the object) can be turned 90 deg. This pattern also permits interchangeability of fixtures between models of same load rating.

All American Tool & Mfg. Co., 8027 Lawndale Ave., Skokie, Ill.

New Oxygen Analyzer—The Model F-3 is the newest addition to the line of Oxygen Analyzers manufactured by Arnold O. Beckman, Inc. Designed for combustion applications in power plants, steel mills, cement kilns, petroleum refineries, and ceramic kilns, the F-3 indicates the oxygen content of flue or process gas automatically. Oxygen is strongly paramagnetic (attracted into a magnetic field), and the unit measures the magnetic susceptibility of oxygen by means of a simple physical principle without recourse to chemicals, filaments, fuels, wicks, or other mechanical aids.

Arnold O. Beckman, Inc., 1020 Mission St., South Pasadena, Calif.

Analog-to-Digital Converter for Spectrometer—Double benefits of time saving and error reduction are claimed when Consolidated Engineering's new "Spectro-SADIC" is used in conjunction with its analytical mass spectrometer in routine analytical work. The instrument system is said to be of particular value in the oil refining and petrochemical industries, where large numbers of very similar mixtures must be assayed daily in standard control work. Data-reduction time, a major portion of the total time required in mass-spectrometric analysis, is cut sharply, according to the manufacturer, greatly increasing the utility of the method. Direct, automatic conversion of mass-spectrometer data into digital form of 0.1 per cent accuracy is claimed and this eliminates the picking of individual peaks on graphical records, it is said, practically eliminating human error.

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

New Electronic Micrometer—A new Model W Electronic Micrometer is said to permit measurements to 0.00002 in. without any measuring pressure being exerted on the work. All measurements are direct measurements. The measuring head consists of an accurate micrometer screw. An electronic circuit, sensitive to five millionths of an inch displacement at the micrometer tip, gives a visual indication at the moment of contact but before pressure is exerted. The Model W Electronic Micrometer is especially designed for use in research, development and performance testing of diaphragms and bellows used in flight instruments, temperature, refrigerator, and other types of controls where a pressureless means of testing is required.

J. W. Dice Co., Englewood, N. J.

New Laboratory Stirrer—With a new "hollow spindle" laboratory stirrer the propeller can be raised or lowered while the motor remains in a fixed position. Using only one propeller, the operator can: (1) vary its working length according to size of vessel employed, and (2) place and remove containers by raising the propeller only, greatly facilitating many stirring operations. The "hollow spindle" is actually the motor armature with a $\frac{5}{16}$ in. chuck at one end and centering device at the other. The noiseless and sparkless 1550 rpm shaded pole motor develops a torque of 5.195 in.-oz.

Eberbach Corp., Ann Arbor, Mich.

New Stereo-Microscope—Offered as an aid in speeding production, maintaining quality controls, an imported binocular microscope is said to be useful for any inspection operation, examination, counting, checking, dissecting. The unit features wide field, erect image, unusual depth of focus and long length of working space. Fixed three-power objective, with 3 pairs of matched eye pieces to give powers of 15 ×, 30 × and 45 ×. Rack and pinion focusing.

Edmund Scientific Corp., 160 E. Gloucester Pike, Barrington, N. J.

"Thimble-Size" Accelerometer—A new "thimble-size" accelerometer of Endevco Corp. is said to provide an improved research instrument for the measurement of high frequency shock and vibration. The small size and light weight permit the testing of small components under actual or simulated shock and vibration conditions it is claimed. The unit is said to be ideal for missile, aircraft, and vibration table measurements.

Endevco Corp., 180 E. California, Pasadena 1, Calif.

New Flash-Point Tester—A new Pensky-Martens Tester, available in both gas and electrically heated versions, now has the heater as an integral part of the assembly; all other components are mounted on the same tripod support for simple transporting. On the electric model, the variable transformer permits precise heat input control to stay within the ASTM heating rate specifications of 9 to 11 F per minute. And its heater has been cast into the unit that forms the air bath, eliminating the strap-on heater and the necessity for attachment. It is claimed that the newly designed cup cannot tip when set on the laboratory bench. The new cup is said to stand thermal shock much more efficiently. The electrically heated model used 115 volt 50–60 cycle ac. Both models include stirring motors (for use on 115 volt 50–60 cycle ac) and low range (20–230 F) and high-range (200–700 F) thermometers.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

New Catalyst—A new, specially prepared, finely divided iron powder is now available for use as a combustion accelerator in metal analysis. Its name, "Combax Accelerator," is derived from Fisher Combax Combustion Boats, already available. The Fisher Induction Carbon Apparatus is used for carbon determination of steel. The iron powder is added to the sample to be ignited when the sample is non-magnetic and therefore difficult to fire by induction heating. The material is prepared by a hydrogen reduction process which frees it from carbon and sulfur impurities.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Unit for Measuring Balanced Impedances—Accurate measurements of balanced impedances in the frequency range from 50 to 1000 mc can be made with the help of the new General Radio Type 874-UB Balun. The balun, a tunable semiartificial half-wave line, acts as a transformer and makes it possible to connect a balanced impedance to an unbalanced coaxial system such as is used on high-frequency measuring instruments. The balun has two important advantages over a conventional transformer—it can be tuned over a wide frequency range and has very low losses.

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

New Coaxial Adaptors and Accessories—Adaptors are now available to connect from General Radio Type 874 Coaxial Connectors to either male or female of Types N, C, BNC or UHF high-frequency connectors. The adaptors are said to have excellent electrical characteristics with a low VSWR even at several thousand megacycles. These adaptors not only make it possible to utilize the advantages of the Type 874 line when measurements are made on equipment fitted with military-type connectors, but also make it simple to interconnect systems using any of the various connectors. A new adjustable line is also announced for use in measurement work requiring a section of coaxial line of adjustable length but with uniform impedance. The type 874-LK is a 50 ohm line adjustable from 58 to 80 centimeters. It has VSWR of less than 1.10 at 2000 mc. A shielded component mount has also been added to the GR Type 874 line of coaxial elements to facilitate the accurate measurement of resistors, capacitors, and inductors.

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

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(*Continued from page 74*)

Industrial X-ray Unit—Developed and used in Europe, the Fedrex portable x-ray unit for industrial radiography is now available in this country in a new and improved model, under the trade name of "Andrex." The unit represents a departure from traditional design, in that x-ray tube and other high-tension parts are combined in one single all-welded steel tank. High tension cables, cooling connections, separate transformers, and cooling pumps have all been eliminated, resulting in a unit so small and light that it can be carried by one man into working spaces that formerly were inaccessible or entered with the greatest difficulty. Andrex claims a remarkably high efficiency in operation. According to the manufacturer, field reports show that in erection work "Andrex" gives 2 to 3 times the number of radiographs per working day than any other equipment.

Holger Andreasen, Inc., 703 Market St., San Francisco, Calif.

Radiation Detection Instruments—A new 16-page, illustrated brochure, describing in detail all types of radiation detection and health instruments. Included are electronic instruments; Geiger, proportional and scintillation counters; health instruments; shields and safety devices. Cataloged for the first time is complete reactor control instrumentation.

Dept. FP-11, Radiation Counter Laboratories, Inc., 5122 W. Grove St., Skokie, Ill.

90 deg Spectrometer for X-ray Analysis—A new 90 deg Geiger counter x-ray spectrometer said to provide a powerful analysis tool for use in research and educational fields as well as for production control is now available. Designed to provide a full standard range of operation, the new instrument employs an air-cooled x-ray tube and a goniometer having a radius of 130 millimeters. Angular range is minus 10 deg to plus 90 deg (two theta). Angles can be read directly from a dial or from a strip chart (degree pen optional). The angle can be varied quickly by a manual drive or by employing the incorporated motor drive. The Geiger-counter position is continuously readable to 0.01 deg (two theta) over the full range.

Research & Control Instruments Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Burets—Recently announced is the development of a new line of automatic burets to be known as "Teflomatic Burets." Two models are available—TJ-715 for acids and TJ-740 for alkali solutions. Both are similar to the standard automatic burets made by this company, but they differ in that the "Teflomatic" has a solid Teflon plug which prevents sticking or binding, and the joint is Teflon-coated so that the buret can't freeze to the bottle. Teflon provides a firm, secure seal which is broken by a slight twisting of the two parts.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Petroleum Testing Equipment—Announcement is made of the introduction of an extensive line of petroleum products testing laboratory equipment. According to the supplier, all of the equipment has been designed and built to conform rigidly to relevant ASTM and Federal Specifications. It is said that many of the items supplied are not listed in any current commercial catalog. Two services offered by the firm are of special interest: (1) an offer to modify the standard design of all equipment to conform to material and design changes desired by the customer, (2) an offer to custom design and build equipment for nonstandard tests. Literature available from the firm lists apparatus used in over 50 specifically cited ASTM tests of petroleum and petroleum products.

Technical Equipment Co., 4348 San Pablo Ave., Emeryville 8, Calif.

Testing Machine for Large Loads—A new floor-type, universal testing machine permitting great working capacity on a finished machine pad bed of 4 by 15 ft has just been announced. Designed especially for large specimens of work such as bridging members, aircraft wings, and concrete columns, this 200,000 lb machine offers a number of new features. The crosshead is driven by a Thymotrol motor mounted directly on the crosshead instead of at the bottom of the machine. Raising and lowering of the crosshead on fixed screws is said to permit a more direct and rigid drive with less torsion in the screws.

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Speed range of the motor is 20:1 providing an over-all loading speed of 0.025 to 0.5 in. per min and a traverse speed of 15 in. per min. Special flexure plate construction in each plane allows eccentric loads to be used. Welded steel, fully stress relieved, is used throughout.

Young Testing Machine Co., Skelton Bldg., Bryn Mawr, Pa.

Catalogs and Literature

Laboratory Apparatus—The current issue of "Cenco News Chats," published by Central Scientific Co., contains several articles concerning new developments in scientific equipment and laboratory apparatus. Of particular interest is an article describing the new Maisch Stainless Steel Metering Pumps and another on the Maisch Pipette Control System. The lead story concerns Dr. Frederick G. Cottrell, inventor of the Cottrell Precipitator.

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

New Edition of Safety Manual—The new edition of the "Manual of Laboratory Safety" is available, free of charge, from Fisher Scientific Co. The Manual has been called "the most useful work of its kind designed specifically for laboratories," and safety committees of a number of private and Government institutions have made it required reading for all new personnel.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

General Laboratory Supplies—Recently announced is the publication of a new four-page, two-color folder illustrating and describing over 15 laboratory items. These products, most of which are exclusively sold by E. Machlett & Son, were selected because of their general widespread laboratory usefulness.

E. Machlett & Son, 220 E. 23rd St., New York, 10, N. Y.

Water Stills—Just announced is the publication of "Bulletin No. 950" on Industrial Water Stills and Accessories. This new 12-page booklet contains descriptions and illustrations of what is claimed to be the most advanced equipment available for water distillation and storage. Recommended especially for hard waters, these stills range in size from 5 to 100 or more gallons per hour; storage tanks, from 10 to 500 gallons capacity. The Bulletin includes specification tables and floor diagrams. Steam, gas, and electrically heated units are discussed, as well as double and triple still assemblies and automatically controlled assemblies. A page is also devoted to the laboratory size "Streamliner" Stills (1 to 4 gal per hr).

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Laboratory Apparatus—The sixteenth edition of "What's New for the Laboratory" has been announced by the Scientific Glass Apparatus Co., Inc. Twenty-seven items are featured. Included are: A high-speed projection type balance which can also be used for analytical work; a surface temperature thermometer; microscope with built-in illuminator; noncorrosive optical cover glass; sulfur determinator; an automatic buret with solid Teflon plug and Teflon-coated joint; two accessories for the Beckman Model DU Spectrophotometer; and various other laboratory aids.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

Temperature-Humidity Test Chambers—A new two-color four-page bulletin on temperature-humidity test chambers is available. Chambers covered in this bulletin can simulate temperatures from −100 F to +200 F and relative humidities from 20 to 95 per cent. Specifications give data on heaters, humidification, dehumidification, temperature and humidity controllers, compressor equipment, etc.

Bulletin TR, Tenney Engineering, Inc., 26 Ave. B, Newark 5, N. J.

Instrument Company News

Beckman Instruments, South Pasadena, Calif.—Arnold O. Beckman has announced the appointment of Taylor Fletcher as Manager, Special Products Div., Beckman Instruments, Inc. Fletcher replaces the former manager, John F. Bishop, who was recently made Assistant General Manager of this company.

Central Scientific Co., Chicago, Ill.—John F. Green has been named general sales manager of Central Scientific Co., Chicago, vacating the post of Chicago district sales manager, according to John

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T. Gossett, president, in announcing two new appointments. Jack N. Widick, formerly assistant to the general sales manager, has been named Indiana sales representative, a post covering northern Kentucky and central Illinois as well as Indiana.

High Vacuum Equipment Corp., Hingham, Mass.—Announcement was made of the recent organizing of the High Vacuum Equipment Corp. for the development, design, and manufacture of high vacuum equipment used in the fields of electronics, metallurgy, plastics, and metals.

The address will be High Vacuum Equipment Corp., 349 Lincoln St., Hingham, Mass.

Metco Corp., Dayton, Ohio, a newly formed company for the development and manufacture of test equipment and related products, has opened offices and laboratories in Dayton, Ohio. Announcement was made by Harold E. Folkerth, president, who said the firm was organized to meet the growing demands of industry for test equipment.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.—Plans for a $900,000 expansion of the main plant of Minneapolis-Honeywell Regulator Co. were announced recently by Harold W. Sweatt, president. It is the third expansion move to be disclosed by the automatic controls firm in recent weeks. Sweatt said application had been made to government agencies for a certificate of necessity to construct a two-floor addition that will add 59,000 sq ft of floor space to the present main plant building which, in addition to extensive manufacturing operations, also houses the company's executive and administrative offices.

News of Commercial Testing and Research Laboratories

Hunter Associates Laboratory, Falls Church Va.—A new service organization called "Hunter Associates Laboratory," or HUNTERLAB for short, has been formed. A small photometric and colorimetric laboratory is being equipped at the above address in suburban Washington, D. C. The organization offers research and manufacturing organizations concerned with the appearances of materials the following types of services: (1) advice on appearance instrumentation; (2) tests of materials for either routine or special appearance properties; (3) designs of improved appearance-testing instruments; (4) consulting and development service (including construction of special equipment where necessary) for testing, inspecting, and in some cases automatically controlling the appearance, quality of manufactured and processed materials.

Smith-Emery Co., Los Angeles, Calif.—The fall issue of "Testing Topics," the periodical of the Baldwin-Lima-Hamilton Corp., contains an extensive description of the Smith-Emery organization and facilities. Of particular interest is the recent installation of a 440,000 lb Baldwin Universal testing machine said to be the largest of its kind in the southwest. Already used for the testing of metal construction materials, it has also been valuable for testing special metals for the Atomic Energy Commission according to the manufacturer. Other facilities include a number of smaller Universal testing machines, and a wide range of equipment for testing materials of construction. The laboratory is also equipped to analyze water, petroleum, metals, ores, paints, and vegetable products. The technical staff at present numbers 55. The firm has been serving the area for 41 years.

Don L. Quinn Co., Chicago, Ill.—Announcement is made that Wilmer J. Balster, who has been vice-president and general manager of this firm, has resigned. He will establish a consulting service in testing, shipping containers, and transportation. The firm will be known as The Wilmer J. Balster Associates and will have as its initial address Mr. Bolster's home address of 3511 N. Sheffield Ave., Chicago 13, Ill. Mr. Bolster is a member of ASTM Committee D-10 on Shipping Containers.